WIRE AND WIRE PRODUCTS

DECEMBER 1958

MORGAN CONSTRUCTION CO.
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WIRE MILLS EJECTORS REGENERATIVE FURNACE CONTROL

MORGAN WORCESTER

OFFICIAL PUBLICATION OF THE WIRE ASSOCIATION

Lee Wilson's 'big jobs...'

give American Steel and Wire greater productivity, better Rods and Wire

AT WAUKEGAN
5 Furnaces, 10 Bases

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Lee Wilson's big 114-inch charge diameter rod and wire annealing furnaces give American Steel and Wire both the speed and quality they require to meet modern-day competition.

The largest furnaces of their type ever built, they will easily take four spiders of heavy rod in a single charge. A high convection system that sends 5 million BTU's per hour is controlled with exacting precision from a central control area.

If you're considering investing in new wire annealing equipment, make certain you check first with Lee Wilson—America's most experienced wire and rod annealing equipment manufacturer.

Lee Wilson* ENGINEERING COMPANY, INC.
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HIGH CONVECTION ANNEALING FURNACES
MAKE THE BEST METALS BETTER

Greetings of The Season

At this Season of the Year, when hearts are lighter and the warmth of brotherly love is universal, we of Standard Industrial wish our many, many friends, customers and customers-to-be, the Merriest of Christmases and a most Prosperous New Year.

It is with a great deal of satisfaction that the Year of 1958 can be reviewed—it has brought us all new friends and successes, yet in spite of some trials, tribulations and, yes, even failures—we can still smile and rejoice.

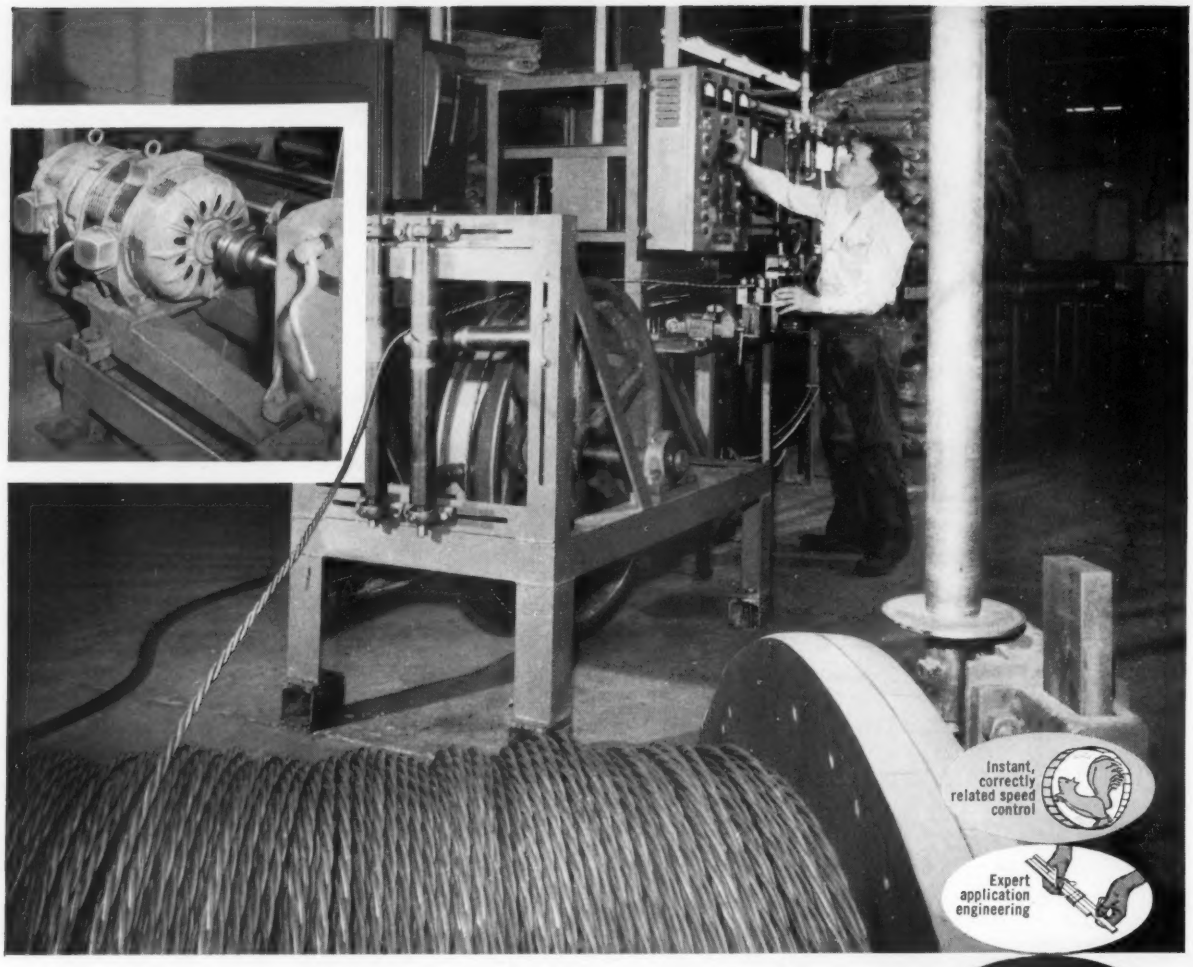
Our best regards to the most wonderful group of men in the world—you wire men! Thank you for your many kindnesses and your unfailing courtesy to us.

Sincerely,

Standard Industrial
COMPOUNDS CO., INC.

FRANKFORT, ILLINOIS
Telephones: 2131-2141

Standard Industrial has pioneered in most of the outstanding contributions to better wire drawing through better lubricants. Consult Standard Industrial for the solution of your difficult problems.



Insulate every foot of cable uniformly and at less cost

Louis Allis Ajusto-Spede® AC drive automatically synchronizes speed of wire and flow of insulant in extrusion process

There is a *proven* way to increase output and to slash costs in the production of insulated wire cable. The solution: provide precise electrical adjustable speed control for your wire lines by using Louis Allis Ajusto-Spede AC drives in your extrusion process.

This remarkable drive automatically synchronizes the speed of the capstan, extruder, and take-up. It assures proper tension on the wire at all times—cuts rejects to the bone because every foot of cable is insulated with the exact amount of insulant that customers specify.

Ajusto-Spede gives you "one-dial" master speed control — converts your process into a smooth, cost-cutting operation. Now there's no need to change mechanical setup to insulate wires of varying sizes. You merely change the speed settings.

If your operation is too costly, it's time to ask your local Louis Allis sales engineer for help. He can draw upon long engineering experience and a complete line of adjustable speed drives to put your wire line on a more profitable basis.

Ajusto-Spede drives are available in sizes from 1 to 75 hp, with adjustable speed from 0 to 3400 fpm. What's more, you have a choice of mechanical and/or electrical modifications for every need.

For information, contact a nearby Louis Allis District Office. Or write The Louis Allis Co., 451 East Stewart Street, Milwaukee 1, Wisconsin.

A50-112

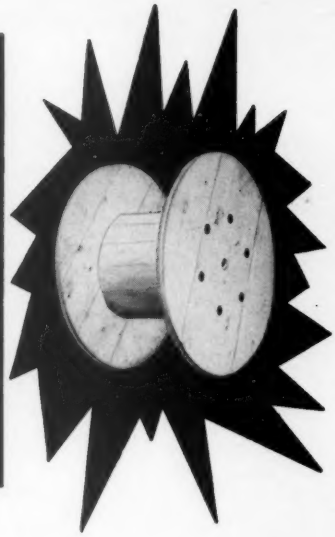
LOUIS ALLIS

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

YES

NON-RETURNABLE

WOOD REELS IN ALL SIZES FOR ALL TYPES OF ELECTRIC WIRE AND CABLE . . . . . .



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- **Lower Freight Costs**
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- **No Bookkeeping**
- **No Deposits Needed**
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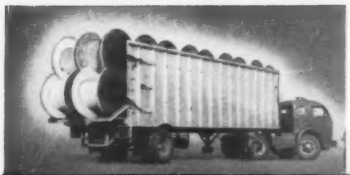

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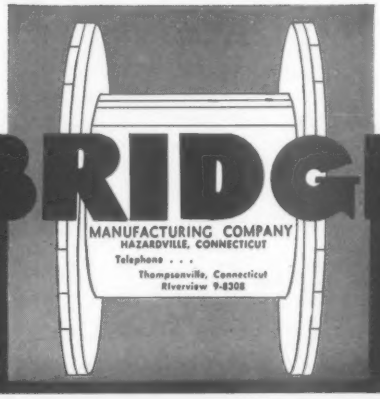
SHIPPING SERVICE IN OUR OWN TRUCKS

within a radius of 200 miles from the plant. Fast freight will bring you Bridge reels within a few days east of the Mississippi.



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MANUFACTURING COMPANY
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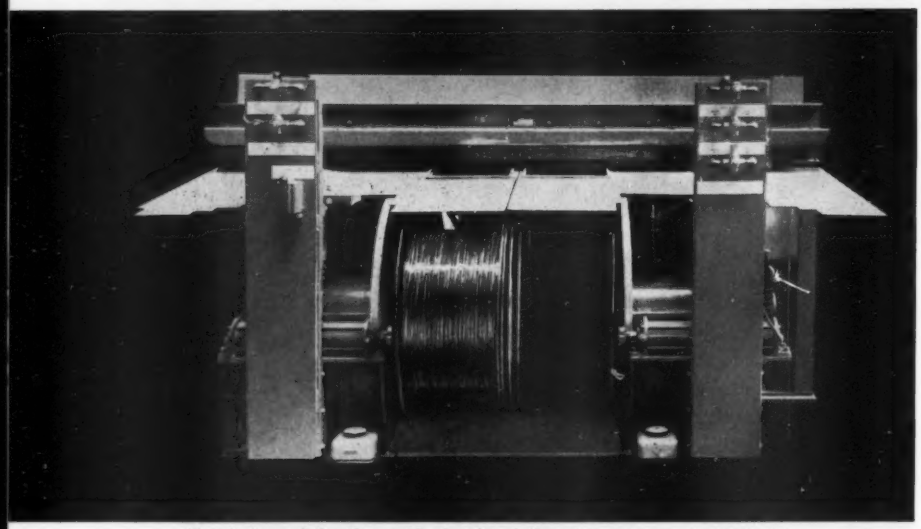
WOOD REELS"

Continureel® Automates Bare Wire Spooling Process

Syncro Spooler Operates at Conventional Drawing Speeds Eliminating Costly Shutdowns Normally Required for Spool Removal

Continureel®, a non-stop dual spooling unit for either hard or annealed heavy-intermediate wire, is the wire industry's only automated bare wire spooler for high speed wire drawing processes. This unit is recommended for spooling at speeds up to 4000 FPM for copper and higher speeds for EC aluminum. Its automatic features make possible continuous winding, transferring wire from full to empty spools, and stopping the full spool without interrupting production. Continureel is capable of winding 1000 pound spools and automatically provides long wire ends accessable for subsequent welding.

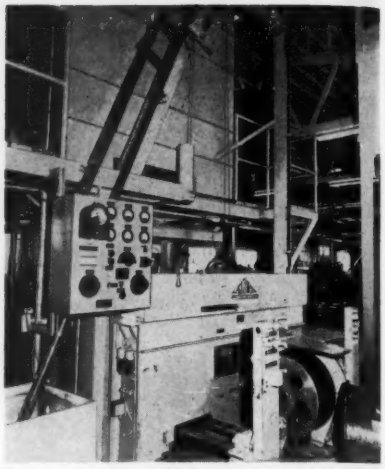


Front view of Continureel® showing full and empty spools. Both drives are in extended positions. Normally, the empty spool would be retracted and in operation.

The Continureel Spooler is a complete double reel unit (illustrated above) mounted on a structural steel base. Dual expanding-type arbors are independently mounted in tandem on a common center line. Adjustable speed motors including magnetic clutches, power the spooler. Gearing is arranged to provide a means for spool or speed ratio changes.

Each spool drive is mounted separately on heavy steel slide bars and positioned by an air cylinder. Air ejectors are utilized to remove full spools from the arbors to the reel elevator. Lifting spools to the proper arbor position and lowering them to the run-off levels is accomplished by a pneumatically-operated elevator platform.

The wire distributor system, mounted on a transfer head, is placed directly above the two spool positions. The distributor system is powered hydraulically incorporating a motor-driven gear pump, hydraulic control valves, and a traverse cylinder.



Syncro Continureel® in operation producing 1000 pound spools.

Traverse "pitch" may be adjusted to accomodate the size of wire being spooled.

The Syncro Continureel Spooler is completely piped and fitted with all necessary air control devices. Electrical connections are brought to a common terminal box in the rear of the spooler. The Continureel unit has been designed to work in conjunction with Resistoneal®, Syncro's exclusive automated method of annealing in combination with copper wire drawing, and spooling in one continuous operation. The spooler unit can be adapted to wire drawing equipment other than Syncro manufacture.

For a detailed description and specification sheet on the Continureel Spooler direct your request to Syncro Machine Company Dept. C, 611 Sayre Avenue, Perth Amboy, New Jersey.

SYNCRO MACHINE COMPANY
Perth Amboy, New Jersey, U.S.A.
affiliated company: WINGET SYNCRO Ltd. Rochester Kent, England

SYNCRO®
Better Machinery for the Wire Industry

WIRE DRAWING MACHINES • STRANDERS • CONTINUOUS ELECTRIC ANNEALERS • PAYOFFS • CAPSTANS • WIRE INSULATORS • HEAVY DUTY TAKEUPS • TAPERS • SPECIAL MACHINERY

WIRE AND WIRE PRODUCTS*

Reg. U. S. Pat. Off.

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 33 December, 1958 No. 12

Designated as Official Publication By The Wire Association

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pays off for wire converters

It's so easy with

PAYOFFPAK

Starting off a new container of wire is simple as 1-2-3 with Payoffpak. Just take off the lid, put on the dispenser, and thread the wire. You'll use miles and miles of wire—up to 600 pounds of it — before you have to worry about rethreading. Think how that will speed production!

You'll be amazed at how trouble-free production is with Payoffpak, too. There are no turning reels to contend with in a Payoffpak. That means you are never slowed up by backlash, overrun or inertia problems.

Payoffpak is made of lightweight fibre. It keeps tare weight down and makes handling easier. But it's strong! Payoffpak takes rough treatment as a matter of course.

Why not try the modern way of handling and dispensing wire. It saves you time, work and money. So insist that your supplier pack his wire in Payoffpak.

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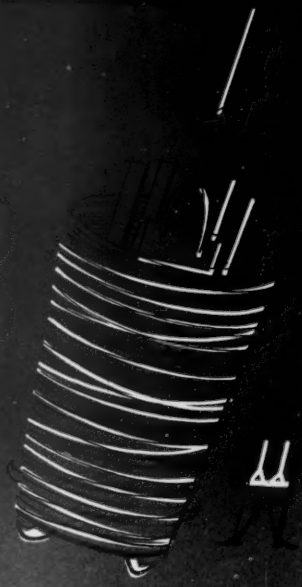
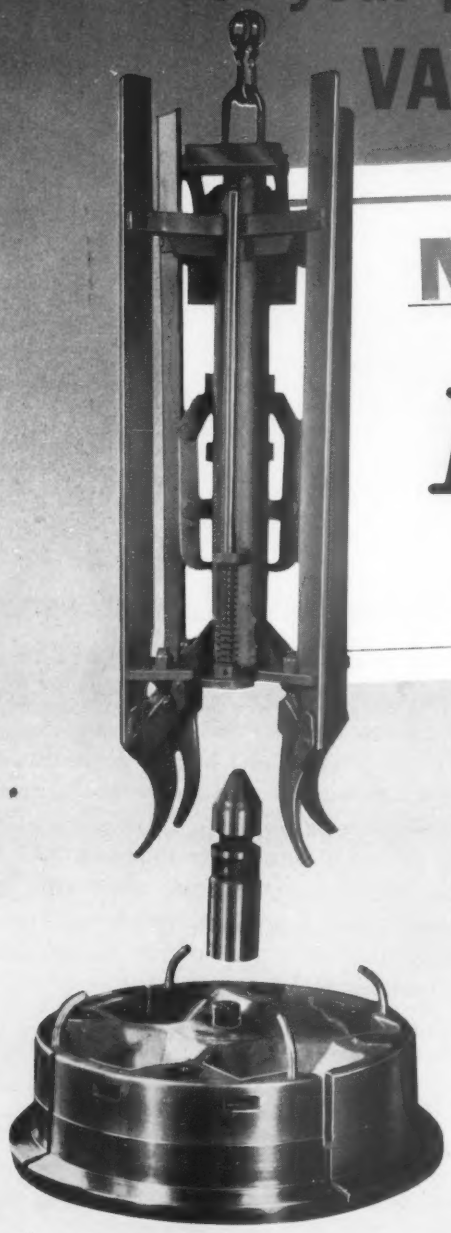


for your present VAUGHN® MACHINES?



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LO-BLOC®

and COLLAPSIBLE STRIPPING SPIDER

Here is a direct, low-cost means of securing BIG BUNDLES from the Vaughn Motoblox® now on your wire mill floor—convert with the new Vaughn LO-BLOC!

The easily-installed combination of Lo-Bloc, pintle and collapsible stripping spider will permit true big-bundle production in your present operation, easy handling, better profits! • Ask us to detail the facts for you.

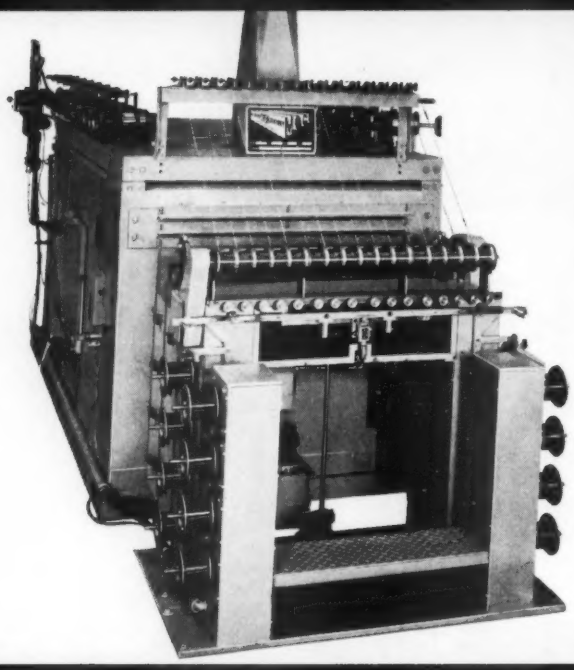
V®

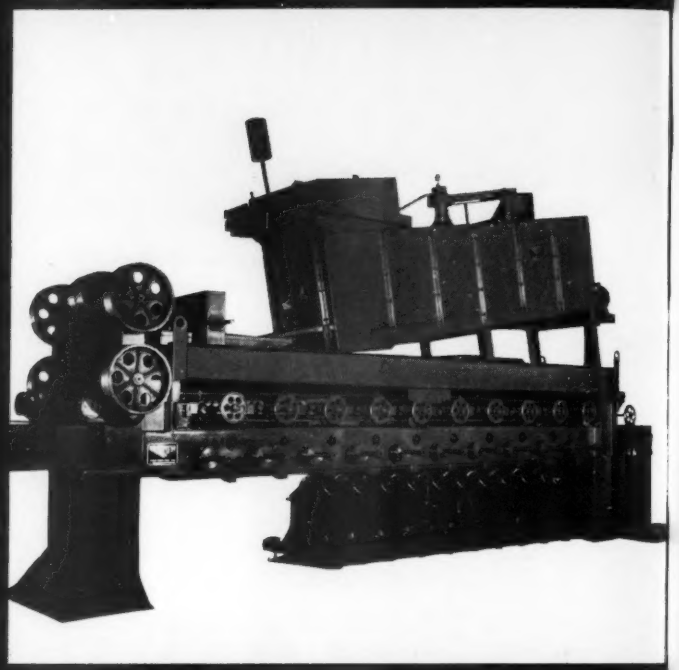
CUYAHOGA FALLS, OHIO, U. S. A.

COMPLETE COLD DRAWING EQUIPMENT—Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys

EXPERIENCE:

Twelve years of development in gas-fired equipment — Three years of "on-the-job" production results





WIRE ENAMELING MACHINES

Typical of the complete line is this type "B" machine which handles wire from 31 A.W.G. to 42 A.W.G.

Five other models complete the range from the finest through large rectangles. The horizontal, high volumetric, recirculating double-pass oven allows greatly increased production by rapid heat impartation and a high degree of temperature uniformity throughout the wire chamber. Other features include: a catalyst within the recirculating stream consumes solvents and releases heat energy, individual clutches in each head of the wire capstan, automatic braking device controlling wire tension.

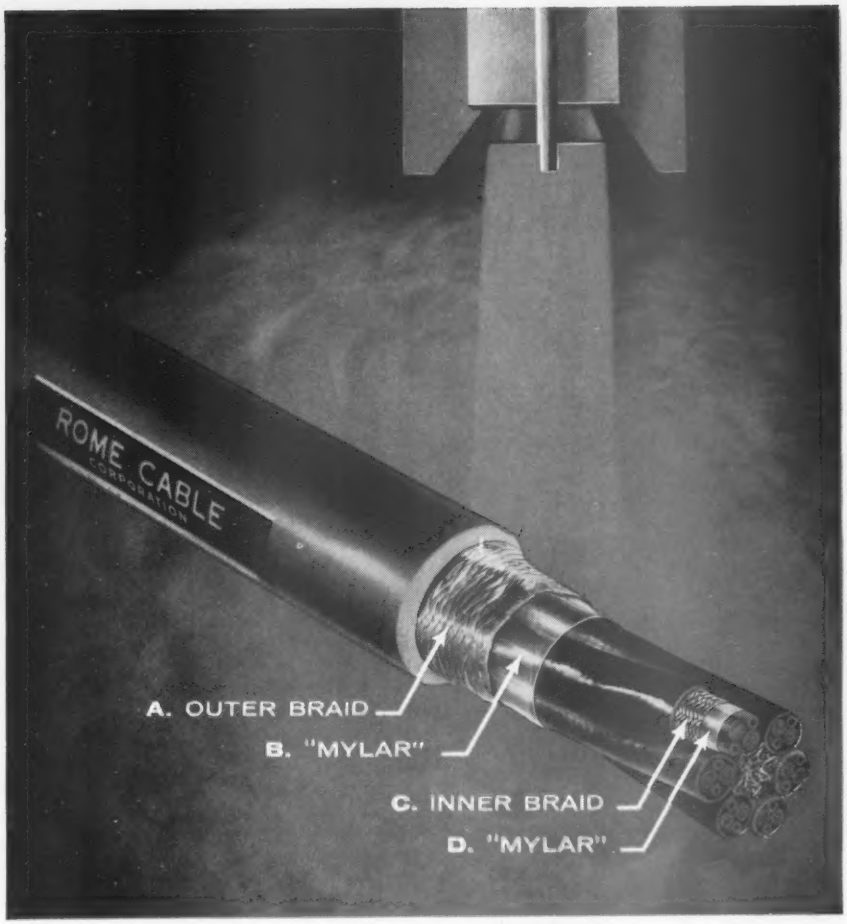
CONTINUOUS BRIGHT ANNEALERS

This is the first direct gas-fired annealer using the heating equipment as an internal inert atmosphere generator. Advanced mixing and burning equipments are utilized which exclude the need for external sources of steam or costly inert atmospheres. They are available in horizontal or vertical mounting positions. MOCO Annealers are of the high volumetric recirculating type with automatic air-fuel gas ration maintained over the entire range. They have a water sealed exit. No external source of inert atmosphere is needed.

WIRE ENAMELING DIVISION

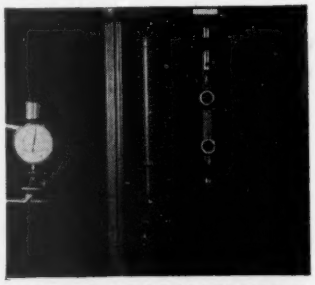
MICHIGAN OVEN COMPANY

425 Brainard • Detroit 1, Michigan

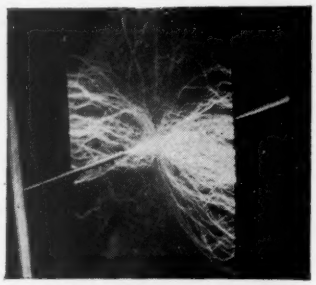


PROPERTIES OF "MYLAR"

"Mylar" offers a unique combination of properties that may help you improve performance and lower costs of *your* product. Here are two of the many important properties for evaluation.



HIGH TENSILE STRENGTH. "Mylar" is strong and durable. Instron Tester shows an average strength of 20,000 psi. It's dimensionally stable . . . resists moisture.



HIGH DIELECTRIC STRENGTH. Average of 4,000 volts per mil . . . average power factor of 0.003 to 60 cycles .

Rome Cable reports . . .

Du Pont Mylar® helps eliminate reject problem in manufacture of cable for "Titan" ICBM

PROBLEM: In designing its instrumentation cable for the "Titan" ICBM project, Rome Cable Corporation wanted a thin, abrasion-resistant tape to protect the insulated conductors from possible puncture by loose strands of the tin-copper braid (See C in illustration). They were also searching for a thin, heat-resistant core binder tape to prevent possible puncture from the outer braid (See A) during extrusion of the cable jacket.

SOLUTION: A tape of Du Pont "Mylar" polyester film for both applications (See B&D). Reason: "Mylar" has the desired balance of mechanical and electrical properties . . . it's tough, abrasion- and puncture-resistant, even in thin gauges. "Mylar" has a high melting point . . . runs well on existing machinery.

RESULTS: The two tapes of "Mylar" eliminated shorted cables due to puncture from loose strands of metal. Solving this problem has helped Rome Cable stabilize production, save money on time and materials and produce a cable that assures better performance and greater reliability in the ICBM.

How can "Mylar" help you? Whether you manufacture heavy-duty cable or tiny capacitors, it will pay you to evaluate the combination of properties found only in "Mylar". And when figured on an area basis, this tough, thin polyester film will often *cost less* than your present insulating material. For more detailed information, send in coupon.

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

DU PONT
MYLAR®
POLYESTER FILM

**"MYLAR" is Du Pont's registered trademark for its brand of polyester film.*

E. I. du Pont de Nemours & Co. (Inc.)
Film Dept., Room EG-12 Nemours Bldg., Wilmington 98, Del.

Please send the new booklet listing properties, applications and types of "Mylar" polyester film available (MB-11).

Application_____

Name_____ Title_____

Company_____

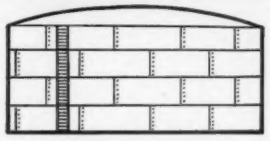
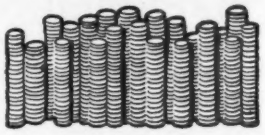
Address_____

City_____ State_____

WANT TO CUT PICKLING COSTS?

YOU CAN WITH ACP RODINE

Even though you are now using an inhibitor in your pickling bath, highly concentrated ACP RODINE can cut pickling costs. Savings in acid, steel and money, as shown in the chart, are based on: a monthly steel production of 15,000 tons; a selling price of $140.00 a ton; and an acid cost of $ .01 a pound.

ACID SAVED	3 lb. per ton	45,000 lb. per month	 540,000 lb. per year
STEEL SAVED	1½ lb. per ton	22,500 lb. per month	270,000 lb. per year
DOLLARS SAVED	$.135 per ton	$2,025.00 per month	 $24,300.00 per year

For complete information about ACP RODINE and the savings it makes possible, write us at our Ambler offices. It will mean no obligation whatsoever.

RODINE is a registered trademark of Amchem Products, Inc.

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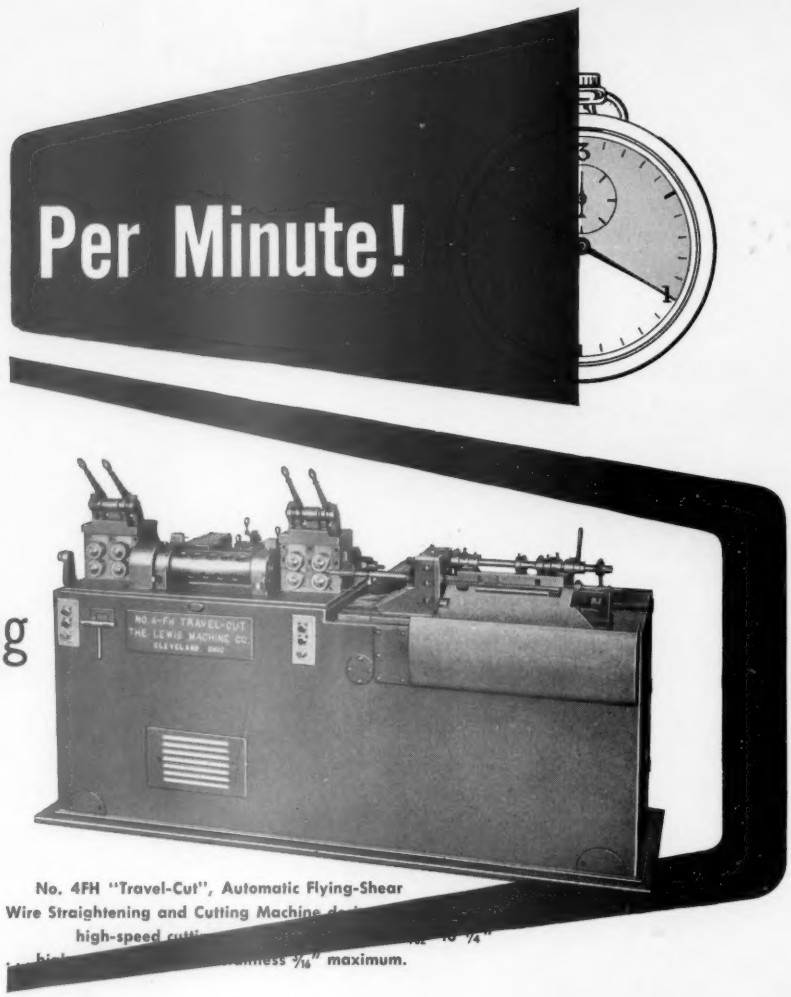
New Chemical Horizons for Industry and Agriculture

500 Feet Per Minute!

With a Lewis Wire Straightening and Cutting Machine



No. 4FH "Travel-Cut", Automatic Flying-Shear Wire Straightening and Cutting Machine [illegible] high-speed cutting [illegible] maximum.

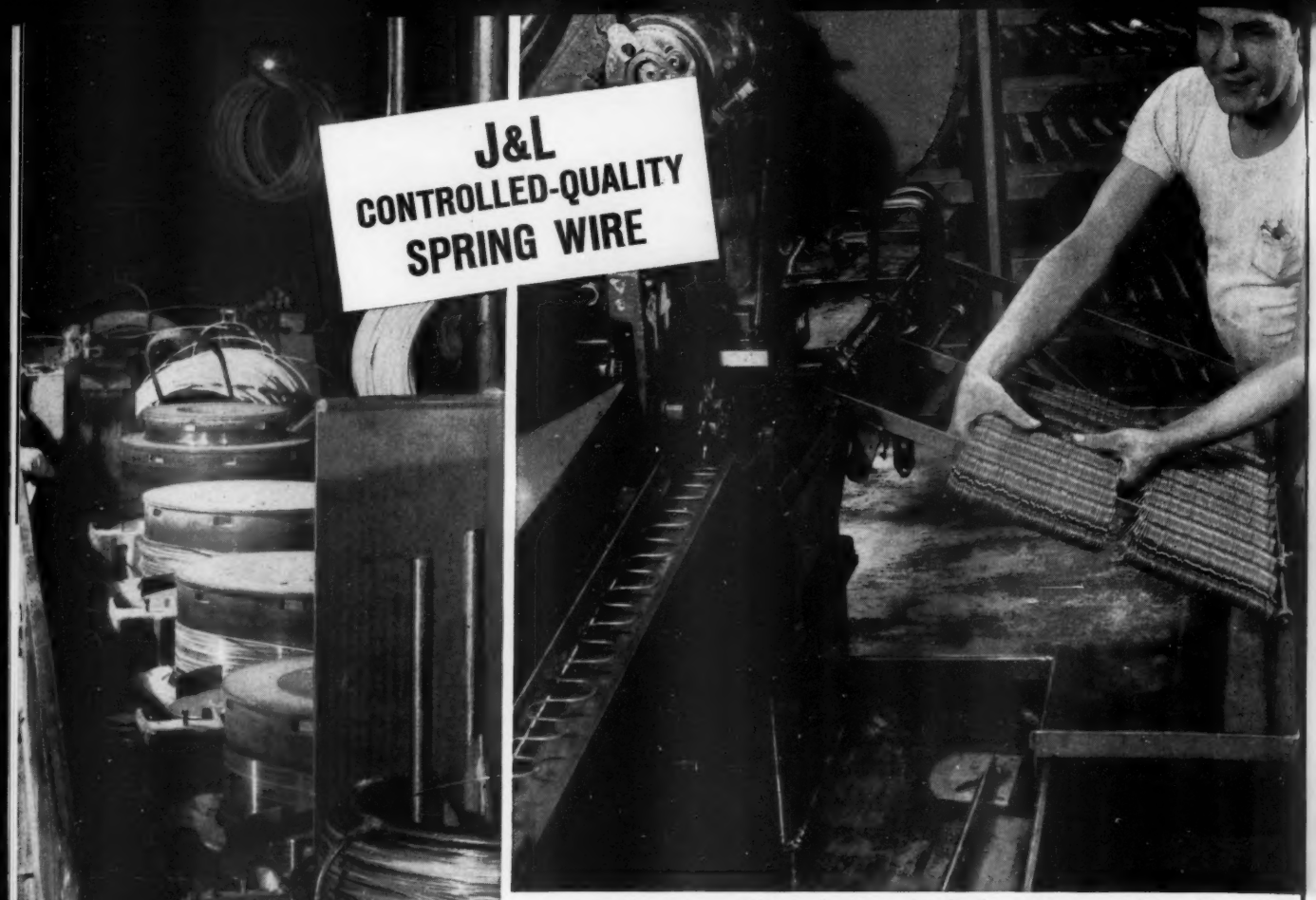
★ The Lewis No. 4FH is typical of the new developments Lewis engineers have perfected to meet tomorrow's production schedules today. For example, the amazing No. 4FH, designed for straightening and cutting short lengths, can produce 18,000, 12"–18" lengths of ¼" welding rod per hour.

Now, Lewis announces a further development, the new No. 4FHA, designed for straightening and cutting any length at speeds up to 500 FPM. The No. 4FHA is a high-speed Travel-Cut Flying-Shear model equipped with Air Clutch and Air Brake.

A compound sliding gear transmission has six flywheel speeds and 20 feed speeds through the range of 75 to 520 FPM, permitting the selection of the correct speed for various diameters and materials.

There are 46 models in the Lewis line designed to handle wire from .012" to 1" in diameter. Write us . . . we have a machine to meet any wire straightening and cutting requirement.

LEWIS



The Universal Wire Spring Company, Bedford, Ohio, uses high carbon MB spring wire from 7½ to 12½ gauge in these new Uniflex springs.

"J&L's spring wire speeds production of new Uniflex springs"

...states Universal Wire Spring Co. official

"We have to fold springs tighter than ever to adapt them to the narrower spaces available in modern designs. The spring wire used for our sinuous corrugated Uniflex springs must then be exceptionally uniform in tensile strength and resistant to deflection under load, and J&L's spring wire has consistently been of this quality," reports a Universal purchasing executive.

J&L achieves this uniformity in spring wire through rigid quality controls in every phase of production from ore mine through finished product. Only first-class quality controls at the steel mill, in balancing chemical analysis, heat treating and drafting, can guarantee uniform spring wire for modern volume production. Every coil of J&L wire is thoroughly tested for uniformity of physical and dimensional characteristics. The resulting high quality speeds production and reduces rejects in automatic operations such as those of Universal.

Call your J&L representative for your next order of spring wire. Or write to Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pa.

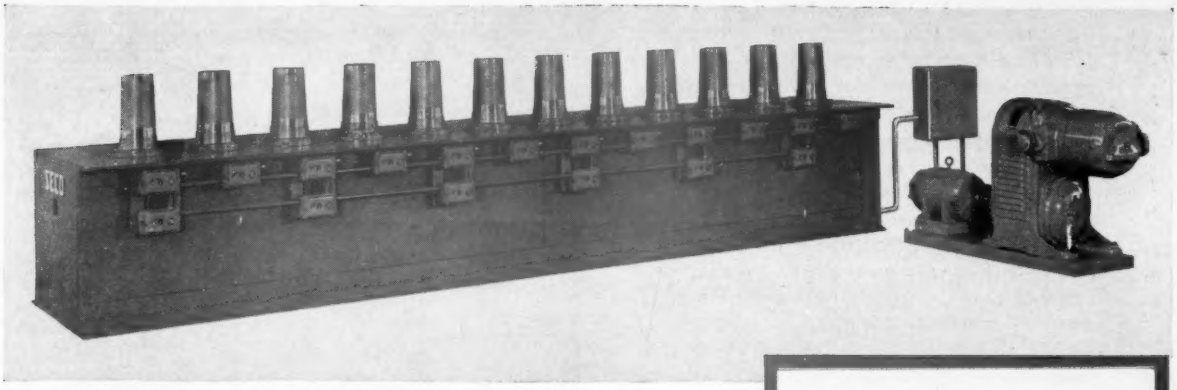
J&L STEEL

Jones & Laughlin Steel Corporation

PITTSBURGH, PENNSYLVANIA

SECO Fine wire TAKE-UP FRAMES

The "last-word" in wire-winding efficiency!



- **Simplified Design and Construction**
- **Synchronized Electrical Variable Speed**
- **Noiseless, Vibrationless Running**
- **Greatly Increased Operating Capacity**

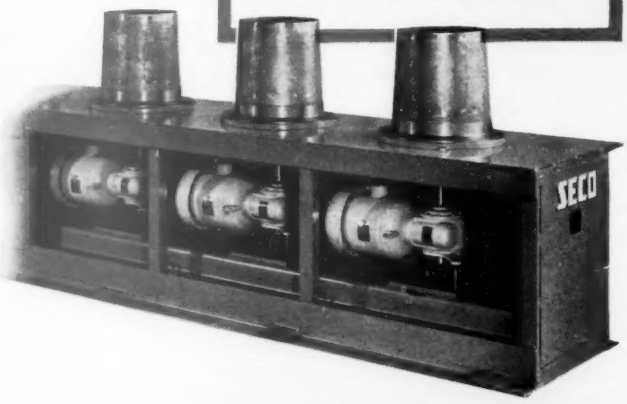
SECO builds take-up frames for handling fine gauge steel or non-ferrous wire on 8", 12", or 16" diameter blocks...with linear wire speeds up to 1,000 FPM or higher. Superior features include a multiple electrical drive system (alternating current) for synchronized electrical transmission of variable speed power.

This gives simultaneous speed changes to all spindle blocks, in ratios up to 5:1 or even 10:1 or higher. It provides push-button stop-start control to each of the gear motors driving each spindle block. Gone is the old bevel gearing, with manually operated clutches for starting and stopping the blocks.

SECO high production take-up frames are constructed to accommodate any number of spindles required. Frames with horizontal spindles can also be built. Call or write for complete information and data. Consultation invited—no obligation.

SHOWN ABOVE:
SECO Take-Up Frame and VARIDYNE Electrical Power Unit which provides synchronized variable speed to the multiple drives. AC current is employed throughout, and the VARIDYNE System "gears" all the drives together by electrical impulses.

SHOWN BELOW:
The AC squirrel-cage induction type gear motors which drive the spindle blocks through hollow bored shafts.



STEEL EQUIPMENT COMPANY
P. O. BOX 737, WARRENSVILLE STATION
CLEVELAND 22, OHIO

SECO

U.S.I.

Vol. II, No. 5

POLYETHYLENE PROCESSING TIPS

HOW CARBON BLACK QUALITY AFFECTS WEATHER RESISTANCE OF POLYETHYLENE

For cable jacketing and many other outdoor applications polyethylene offers substantial advantages over other materials. It is subject, however, to degradation from long exposure to sunlight unless the resin is properly protected.

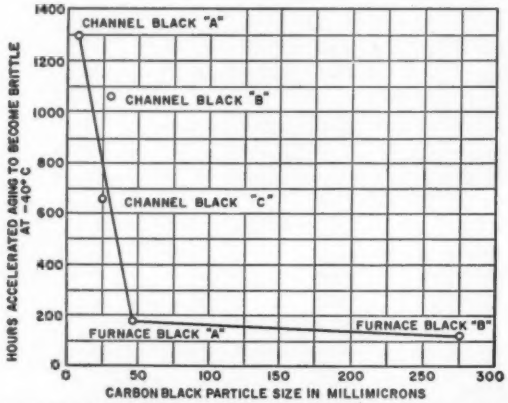
Actually, the aging of polyethylene is the result of a chemical reaction with atmospheric oxygen. Catalyzed by the ultraviolet rays in sunlight, this reaction proceeds more rapidly in outdoor use than is the case with indoor applications. The principal effects of aging are to increase brittleness at low temperature, and to decrease the resistance to stress cracking.

Carbon black dispersed throughout the polyethylene greatly retards this aging, or weathering. However, not all carbon blacks produce the same degree of weather resistance when dispersed in polyethylene. Moreover, the care with which the carbon black is dispersed in the polyethylene is vitally important.

The weather resistance of a polyethylene compound depends on: (1) type and particle size of carbon black; (2) percentage of carbon black in the compound; (3) the dispersion of the carbon black in the polyethylene.

Accelerated aging tests have been devised to approximate the action of years of outdoor exposure.

The graph below shows the great difference in number of hours required in these tests for a polyethylene to embrittle at −40°C when various carbon blacks having different particle sizes are used.



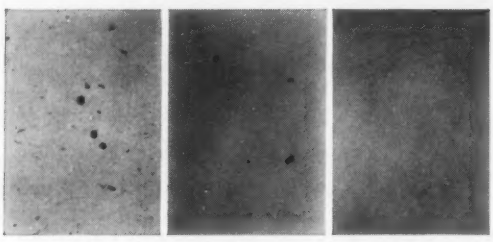
EFFECT OF CARBON BLACK PARTICLE SIZE ON ACCELERATED AGING OF POLYETHYLENE.

The two at right are "furnace blacks", and it will be noted that they are comparatively ineffective. The three at the left are "channel blacks", and obviously, they are many times more effective. This is due to their much smaller particle size – from about 10 to 25 millimicrons, against 50 to 275 millimicrons for furnace blacks.

Weather resistance also increases with the concentration of carbon-black – up to a point. Beyond this point the light screening effect is offset by a decline in other properties.

DEGREE OF DISPERSION IMPORTANT

Carbon black gives maximum protection only when it is thoroughly dispersed in the polyethylene. This presents a difficulty because the smaller the particles, the greater is their tendency to collect into clusters which, once formed, are hard to break up. Tests show that a good dispersion will withstand 15 to 20 times as much exposure to sunlight as a poor dispersion.



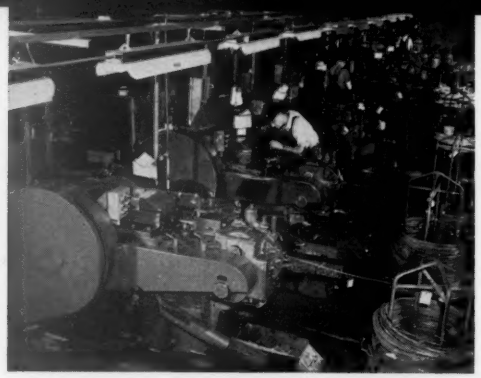
POOR FAIR GOOD

MICROPHOTOGRAPHS OF CARBON BLACK DISPERSIONS IN POLYETHYLENE.

The wire and cable grades of U.S.I.'s PETROTHENE polyethylene resins employ only the finest "channel black" carbon black. Concentration is set at a point which yields the optimum balance of light screening and other properties. Special processing equipment insures thorough dispersion. The result is black polyethylene that withstands long, severe outdoor exposure, yet affords the practical maximum of tensile and other properties.

If you fabricate or use black polyethylene, ask U.S.I. for complete technical data on PETROTHENE resins expressly formulated for weather resistance.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corporation
99 Park Avenue, New York 16, N. Y.
Branches in principal cities



Wire drawn from Youngstown Hot Rolled Wire Rods being fed to a battery of cold-headers at Townsend's New Brighton, Pa., plant that are turning out "advanced design" fasteners for use all over the world.

Accent on Excellence

Youngstown cold heading quality rods

Townsend

As product assemblies must continually improve to keep competitive—the fasteners which hold them together must also be of the highest quality and of the most advanced designs.

To maintain their world-wide reputation for fasteners with "a view to the future", Townsend Company of New Brighton, Pennsylvania uses Youngstown's Cold Heading Quality Rods. They require rods that will produce fasteners with improved tensile strength, fatigue and shock resistance, and surface finish.

Wherever steel becomes a part of things *you* make, the high standards of Youngstown *quality*, the personal touch in Youngstown *service* will help you create products with an "accent on excellence".

THE
YOUNGSTOWN
SHEET AND TUBE COMPANY

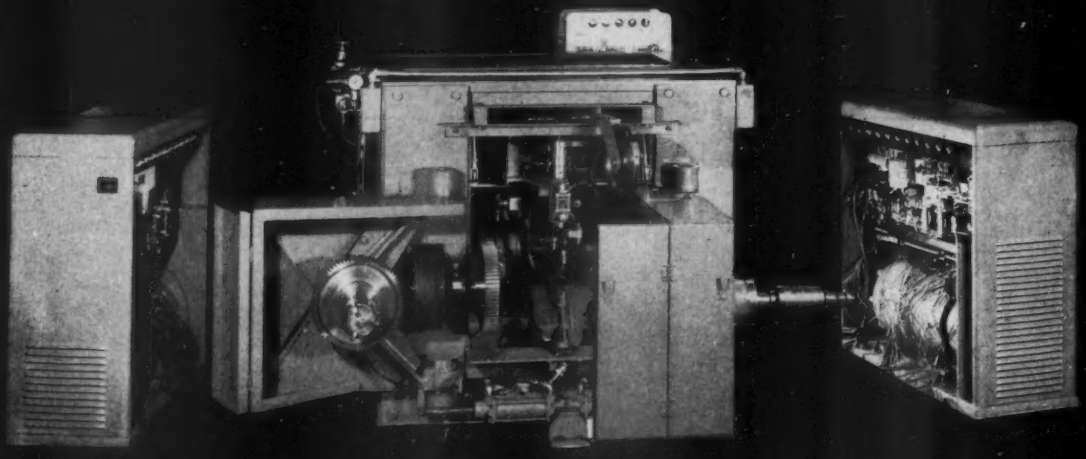
Manufacturers of Carbon, Alloy and Yoloy Steel, Youngstown, Ohio

24-HOUR AUTOMATED WIRE PRODUCTION

WITH THE NEW

LITZLER TRANSFER ★ MATED

DRAWING MACHINE TAKE-UP



★ Round-the-clock winding of all non-ferrous wire types at speeds to 5000 FPM.

★ Rugged electronic control and individual drive systems provide instantaneous transfer between dual reels—automatically!

★ Electronically measured winding of 24" or 36" reels precisely synchronized with drawbench speed and tension.

★ Pneumatic reel clamping and automatic unload-position reel delivery . . . can be arranged for end-out winding . . . adaptable to most existing drawing equipment.

C. A. LITZLER CO., INC.

SOUND ENGINEERING FOR TOMORROW'S PRODUCTION

1817 BROOKPARK RD. **CLEVELAND 9, OHIO** CABLE "CALITZ"

EXPORT REPRESENTATIVE: GILLESPIE & CO. OF N. Y., 96 WALL ST., NEW YORK 5, N. Y.

Are You Getting What You Pay For?

When you pay for HIGH QUALITY high-carbon wire, you want to be sure you get it. You do, when it is supplied by Roebling.

It is unsurpassed in quality, consistently true to specifications, and absolutely uniform in gauge. Hundreds of manufacturers attest to this fact . . . the qualities that they *pay* for—they *get* in Roebling high-carbon wire. The length of our relationship with customers proves it.

We'll be glad to show you what we mean. For information on superior high-carbon wire or cold rolled strip, write Wire and Cold Rolled Steel Products Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

This lightweight "No Charge" spool is typical of Roebling's modern packaging methods that save customers time and money.

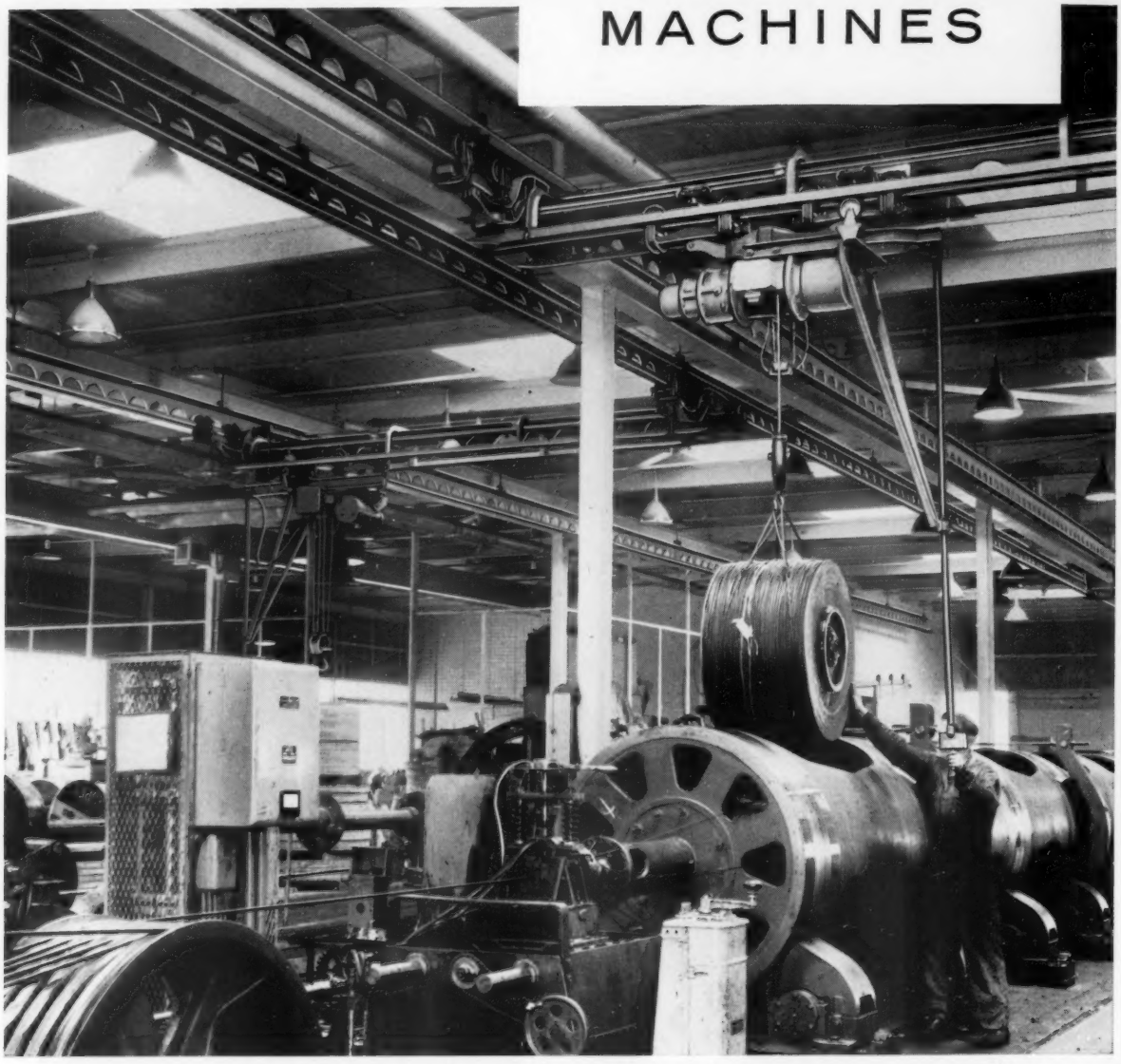
ROEBLING

Branch Offices in Principal Cities—Subsidiary of The Colorado Fuel and Iron Corporation

Roebling... Your Product is Better for it

CRANES FEED WIRE ROPE MACHINES

Lowering a 3000-lb. bobbin of stranded wire into one of the cylinders of a wire rope closing machine. With the smooth rolling Cleveland Tramrail crane this is an easy one-man job.



The three large wire rope closing machines at Wright's Canadian Ropes, Ltd., Vancouver, B.C., are fed 3000-lb. bobbins of wire by Cleveland Tramrail hand-propelled transfer cranes with electric hoists. Because their weights vary from 90 to 300 lbs., empty bobbins are also removed from the machines with the cranes.

A real help in handling bobbins in and out of the rope machines is the rigid arm on the carriers which simplifies spotting the hoist hook over the cylinder openings. The hoist control buttons are located conveniently at the lower end of the arm.

While there are three Tramrail cranes, only two hoist carriers are provided. These are sufficient to handle the work involved and may be transferred from crane to crane as required.

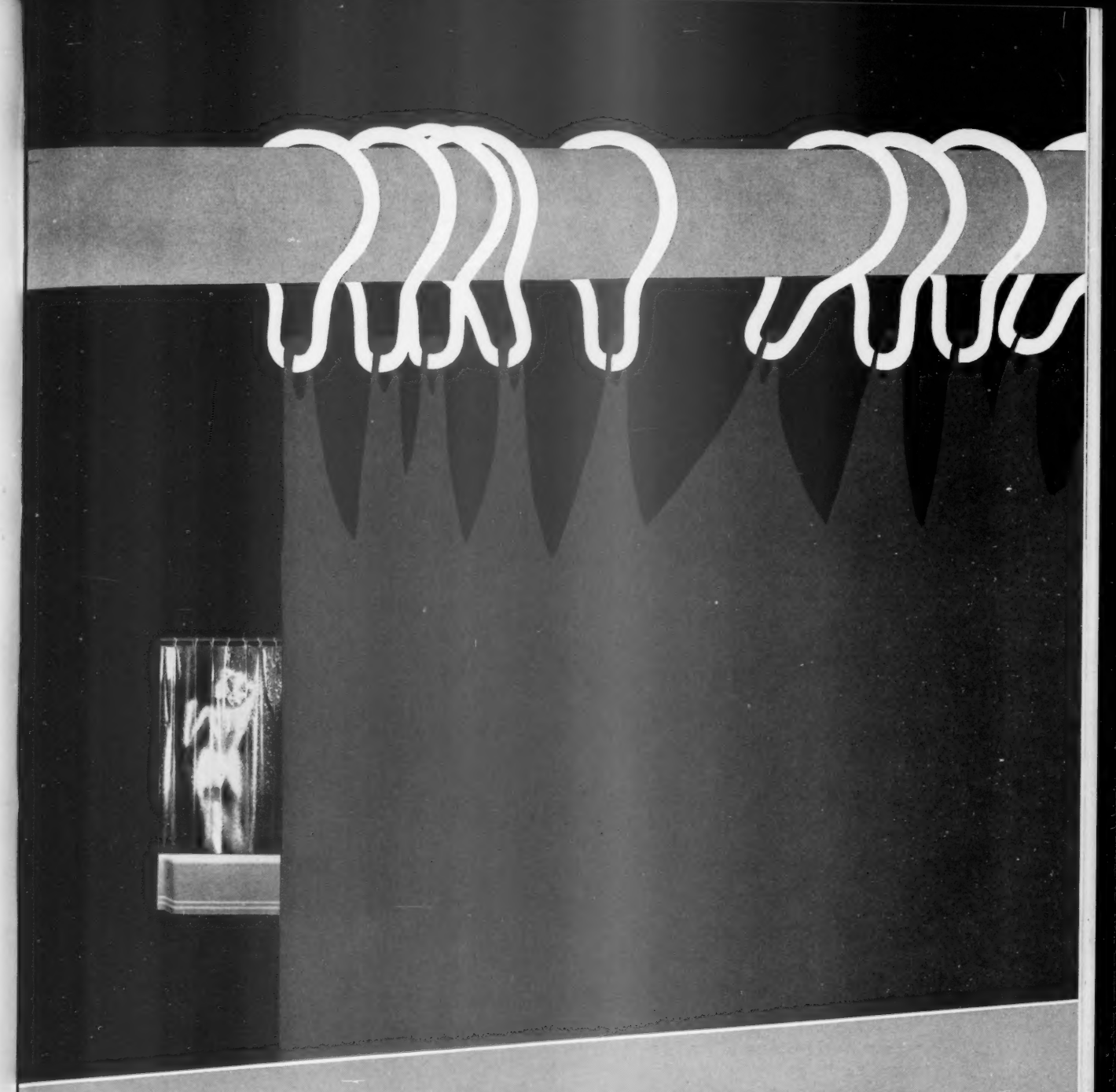
Wrights make various size and kinds of steel rope ranging in size from $\frac{1}{8}$-inch to $2\frac{1}{2}$-inch diameter.

Write for free Engineering and Application Booklet No. 2008. Packed with valuable information.

CLEVELAND TRAMRAIL

Overhead Materials Handling Equipment

CLEVELAND TRAMRAIL DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. • 9225 E. 288 ST. • WICKLIFFE, OHIO



a profitable idea!

These curtain hooks are fabricated on a four-slide machine from Alcoa® Aluminum Wire . . . light, strong, corrosion resistant. They're good looking, can be anodized in blue, gold—various colors. If you use wire in your product, check into the many advantages of aluminum.

Alcoa has set up a special department to work with you on profitable new ideas, new uses for aluminum wire. For immediate action, write ALUMINUM COMPANY OF AMERICA, Wire Products Development, 1993-M Alcoa Bldg., Pittsburgh 19, Pa.

Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM

ALCOA THEATRE • Fine Entertainment • Alternate Monday Evenings

Our Engineering Answer to that

BIG HEAVY DUTY

LARGE REEL TAKEUP OR PAYOFF

is a new shaftless type, available in the following 3 models:

Weights	Max. Reel Sizes
10 Ton	84" to 108"
30 Ton	96" to 120"
50 Ton	96" to 186"

Here are a few of the features that bear emphasis for which we feel that there is no other unit available with comparable advantages. The Unit is available with a floor mounted traverse or mounted on separate carriage as a traversing reel takeup. The above illustration is the traversing reel takeup. The motorized side frames provide for reel adjustment over a wide range of reel sizes. The reel lift mechanism on this shaftless unit is fully motorized with heavy duty lead screw and solid bar guide and is provided with a limit switch for automatic disengagement of lift motor at both running and unload positions.

Driving of the machine is accomplished through heavy duty roller chain and spur gear arrangement remaining in full contact throughout lifting range for maximum efficiency and positive torque transmission. The traverse mechanism employs heavy duty electric clutches for immediate response on reversal and simple disengagement when required. A wide infinitely variable cable lay is effected without slippage through the use of a Cleveland-Speed-Variator. The reel pintles are mounted on heavy duty taper roller bearings designed for long life under heavy loads.

ENTWISTLE
Manufacturing Corporation
1473 ELMWOOD AVE., PROVIDENCE 7, RHODE ISLAND
Over 40 years of dependable service to the Wire Industry

NOW! at low cost twist any number of conductors to make cable up to 1" diameter

only the COOK MULTIPLE INSULATED WIRE TWISTER provides such flexibility

Here's a twister that offers the flexibility required of todays wire mills manufacturing insulated cables. It's truly flexible —you can make any cables required up to 1" diameter.

And, because the COOK MULTIPLE INSULATED WIRE TWISTER is so low cost, it is the practical addition to your plant. Compare it with any other machine on the market doing this work . . . compare its performance . . . compare its cost . . . compare its construction. Why not see for yourself . . . write for complete specifications and prices today.

SPECIFICATIONS

Production	9,000 ft/hr at 7½" lay
Reel Size	30" std. also from 16-36" dia.
Floor Space	6 ft. x 8 ft. max.
Lay Range	¾" to 7½"
Twist	Right or left hand
Finished Wire Size	Up to 1" dia.
Wrapping Head	Optional
Neutralizer	Optional

COOK

MANUFACTURING CO.

50 EAST 25th STREET, PATERSON, N. J. • ARMORY 4-6380

•

CANADIAN AGENT:
E. V. LARSON CO., LTD., TORONTO, CANADA

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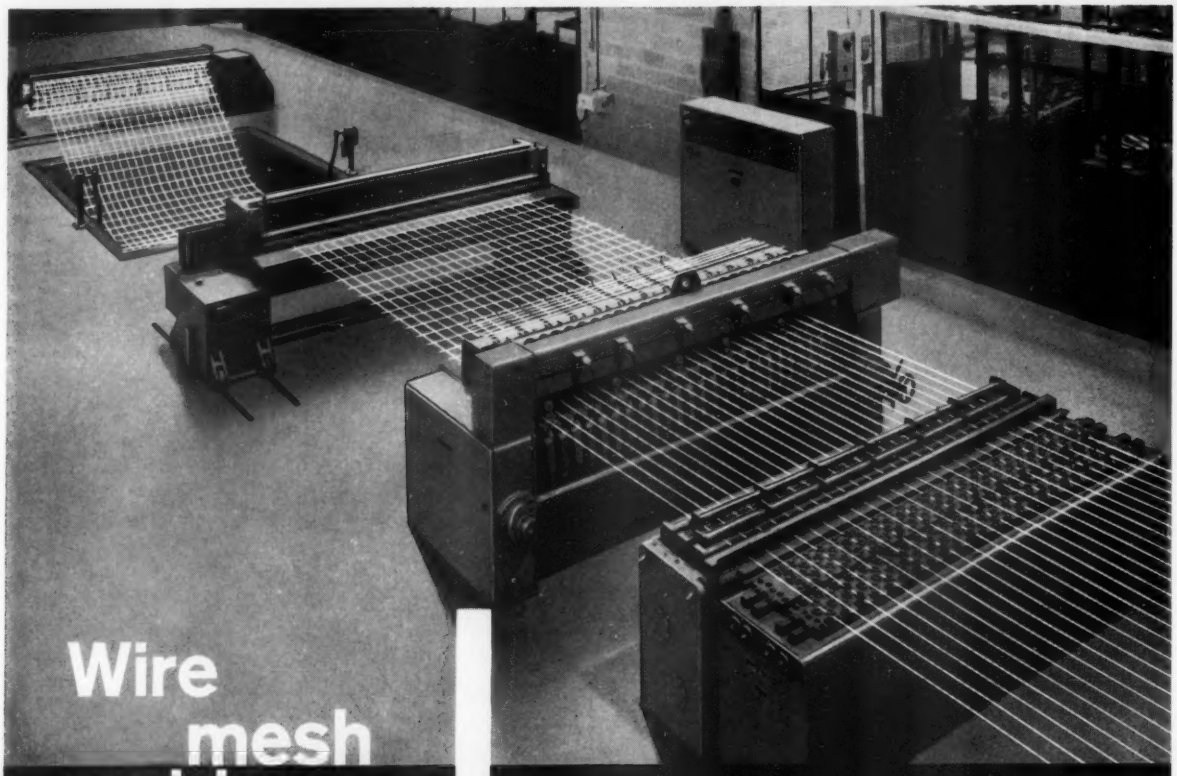
EUROPEAN AGENT:
CAPAMADJIAN LE MONNIER CIE LTD., PARIS, FRANCE

"A recent North American Installation"



Wire mesh welder

for the manufacture of welded fabric sheets and rolls

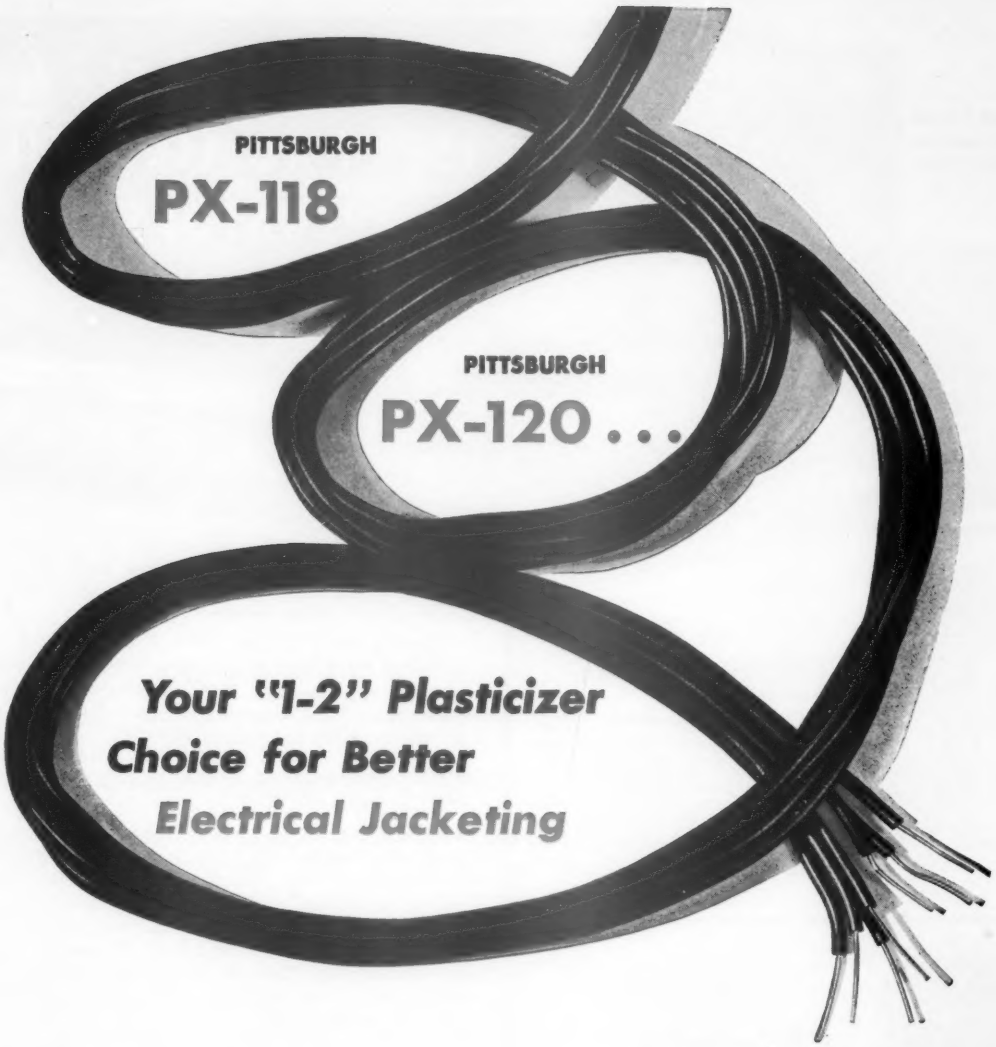
Advantages of the welder

Quick change from one mesh size to another.
Infinitely variable cross and longitudinal wire pitch for any mesh dimension.
Minimum wear of the large-surface electrodes by suitable electrode shape and material, as well as efficient air cooling.
Maximum power factor of the transformers as a result of minimum inductive losses.
Three-phase connection to the mains supply. Electronic current switching by IGNITRON high-power tubes avoiding current surges.
No tearing of the welded mesh and no electrode burning when feeding bent cross wires since the welder stops automatically in such a case.
Effective cushioning of the carriage impact.
Minimum maintenance and servicing thanks to permanent lubrication of all gliding and rotating parts. Automatic oil fog lubrication of all air presses.
Automatic and interlocked sequence of operations and, therefore, always minimum duration of the total welding cycle.
Electrode pressure at every welding spot and feed power are infinitely variable.
Available with attachment for welding three different and preselectable cross wire pitches.

SCHLATTER

Representative for Canada and USA
P. REICHER - Machinery and Equipment
P. O. Box 127, Willowdale, Ontario, Can.

H. A. SCHLATTER LTD. ZOLLIKON/ZURICH
Manufacturers of electric welding machines (Switzerland)



IF YOU'RE faced with the problem of economically maintaining low volatility and good permanence in your vinyl wire jacketing formulations, then you should investigate these two Pittsburgh Plasticizers.

Pittsburgh PX-120 (DiIso Decyl Phthalate) offers low volatility properties which make it outstanding for use in high temperature extrusion processing. And its low specific gravity enables you to enjoy appreciable savings on a pound-volume production basis.

Pittsburgh PX-118 (IsoOctyl Decyl Phthalate) offers the same general advantages of PX-120: Low volatility, high resistance to elevated temperatures, good processing characteristics. Its lower first cost makes it the "best buy" when *economy* is your first consideration.

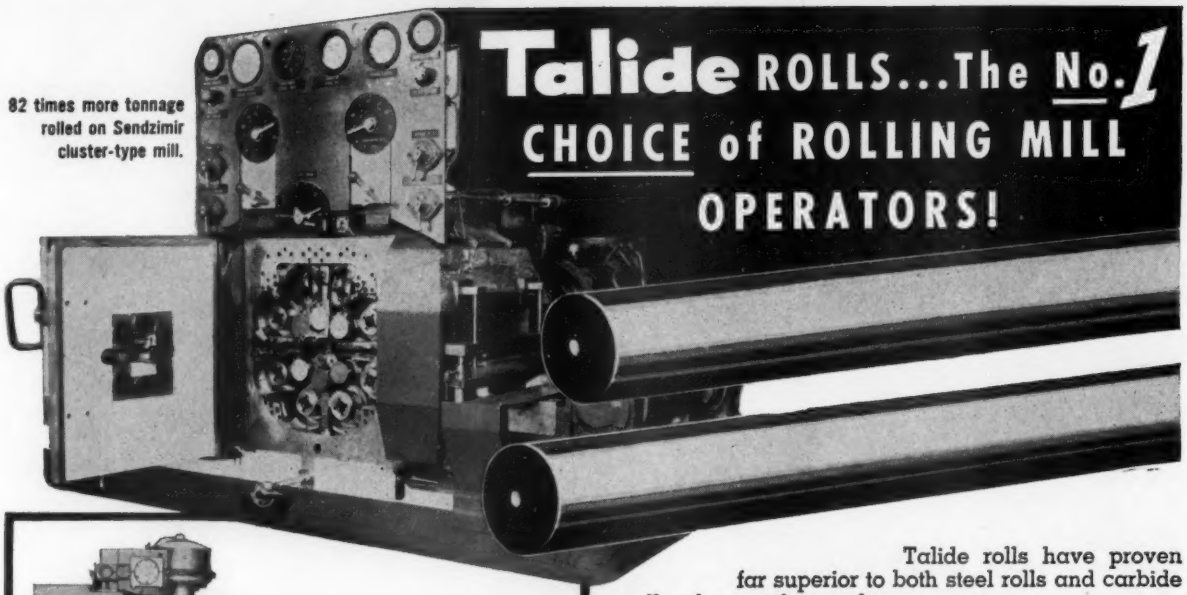
Both PX-120 and PX-118 can be supplied with Bisphenol A added for additional retention of elongation on aging. • *Write today for additional data on these two Pittsburgh Plasticizers.*

Send for Data Sheets and Samples

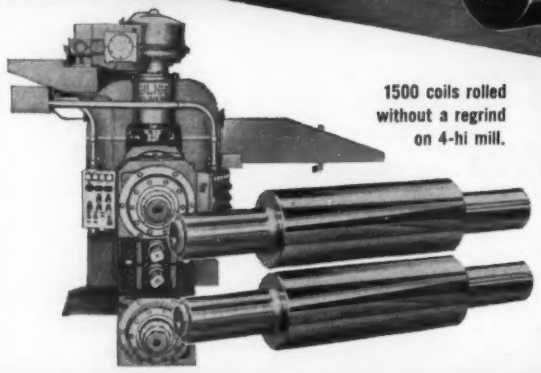
We'd like to acquaint you further with these two outstanding Pittsburgh Plasticizers. Write today for samples and technical data sheets.

PLASTICIZERS • COAL CHEMICALS • PROTECTIVE COATINGS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

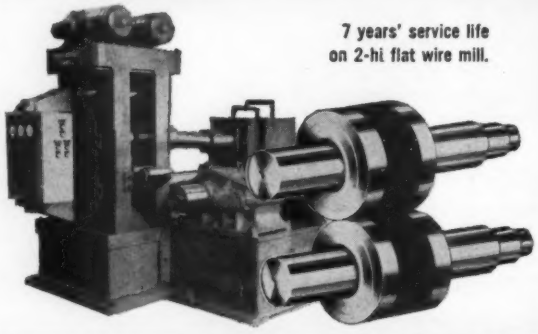
Talide ROLLS...The No. 1 CHOICE of ROLLING MILL OPERATORS!



82 times more tonnage rolled on Sendzimir cluster-type mill.



1500 coils rolled without a regrind on 4-hi mill.



7 years' service life on 2-hi flat wire mill.

Talide rolls have proven far superior to both steel rolls and carbide rolls of any other make.

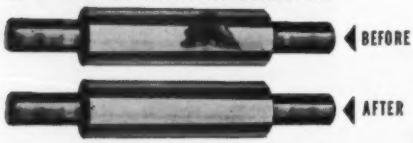
During the last six years Talide rolls have been adopted by every major strip steel producer. Metal Carbides pioneered and developed tungsten carbide rolls and successfully adapted them to all types of rolling mills including STECKEL, BLISS, UNITED, MESTA, STANAT, SENDZIMIR, WATERBURY-FARREL, TORRINGTON, RUESCH, FENN, WEAN, COLD METAL, etc.

Talide work rolls are ultra-hard, extremely dense and porous-free. Manufactured from highest purity tungsten carbide powders, the surface finish of a Talide roll is smoother than one micro-inch. Hard as a diamond, it will take a "bigger bite" than a steel roll. Strip steel of all analyses can be rolled down to thinner gauge, with more accuracy, greater reductions and with fewer anneals than possible with any other roll.

ONLY TALIDE WORK ROLLS GUARANTEE THESE ADVANTAGES

- ★ MORE PRODUCTION
- ★ BETTER FINISH
- ★ LONGER LIFE
- ★ HIGHER SPEEDS
- ★ CLOSER TOLERANCE
- ★ IMPROVED PHYSICALS
- ★ GREATER REDUCTION
- ★ LESS DOWN TIME
- ★ FEWER REJECTS
- ★ LESS MAINTENANCE

EXCLUSIVE REPAIR SERVICE



Broken or damaged carbide rolls can be re-worked to first class condition with all defects eliminated at one-half original cost. Only Metal Carbides offers this service—because of its exclusive hot press method.

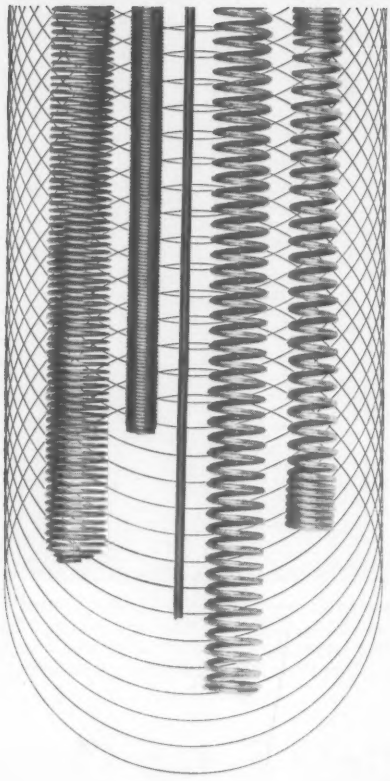
Talide Rolls are made in lengths up to 100", diameters up to 25", and up to 5000 lbs. by weight.

METAL CARBIDES CORPORATION
Youngstown 12, Ohio
Send for new 76-page catalog 56-G.

SUPERSET GRINDING WHEEL

The Superset diamond grinding wheel was specially developed for grinding carbide rolls to highest possible surface finish and luster. Made of 4-8 micron size diamond dust, it imparts a surface finish far superior to any other commercial wheel. Available in sizes up to 25" diameter.

METAL CARBIDES CORPORATION
TALIDE®
YOUNGSTOWN 12, OHIO
HOT PRESSED AND SINTERED CARBIDES • VACUUM METALS
HEAVY METAL • ALUMINUM OXIDE • HI-TEMP. ALLOYS
OVER 25 YEARS' EXPERIENCE IN TUNGSTEN CARBIDE METALLURGY

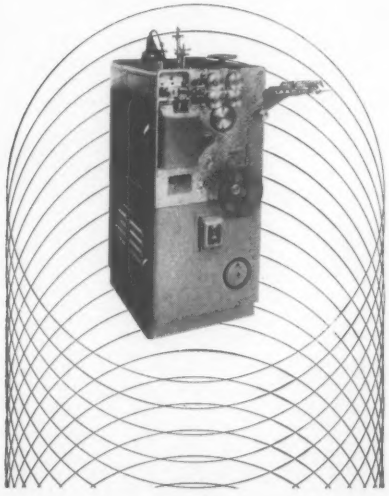


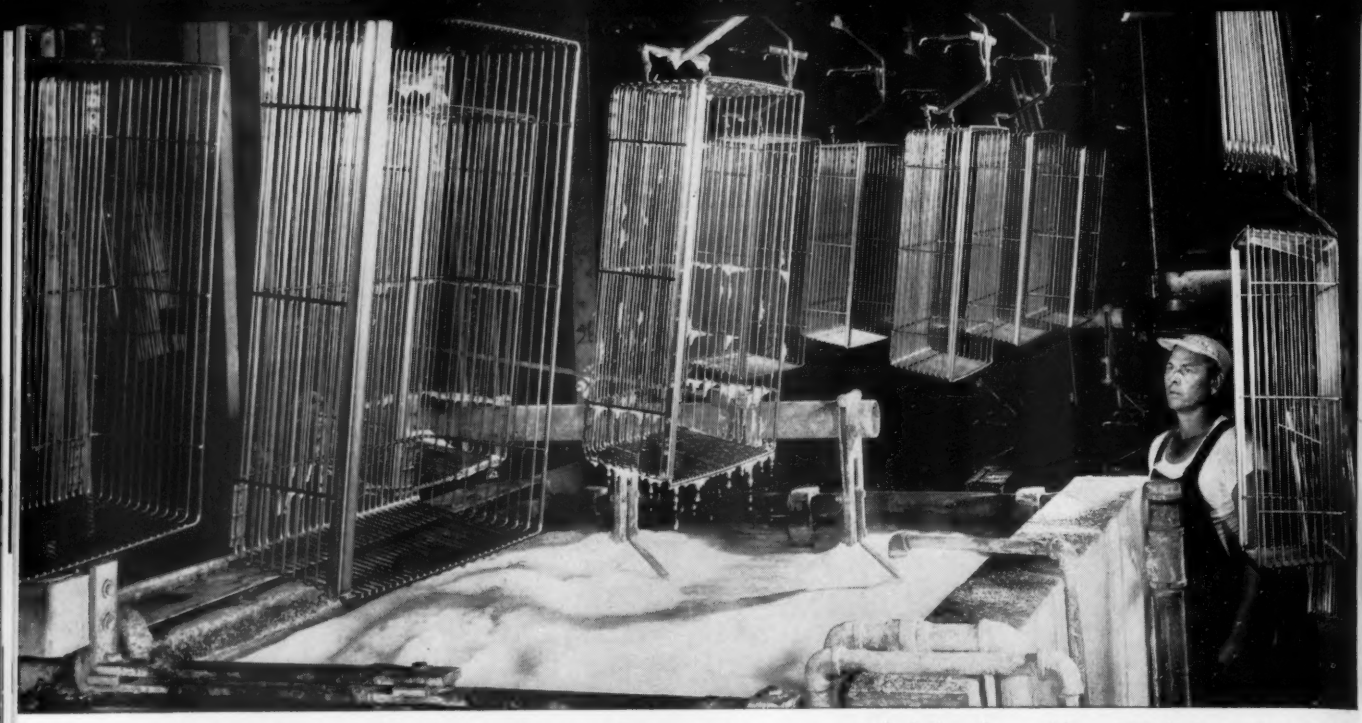
NEW TORRINGTON MULTIPLE WIRE FEED MECHANISM IS THE INDUSTRY'S MOST IMPORTANT ACCESSORY DEVELOPMENT IN 20 YEARS

This is an attachment which virtually doubles the versatility of segment-type spring coilers. By providing multiple stroke feed—with automatic pre-setting for any number of successive strokes—conventional springs can be produced *at any desired length*, and up to twice as fast as on a clutch-type coiler of equivalent size! ▪ Meanwhile, the operation retains the inherent accuracy of the segment coiler, and the use of the pitch, diameter and cutter mechanisms. ▪ Full data, specifications and engineering service upon request.

THE TORRINGTON MANUFACTURING COMPANY

TORRINGTON, CONNECTICUT • VAN NUYS, CALIFORNIA • OAKVILLE, ONTARIO

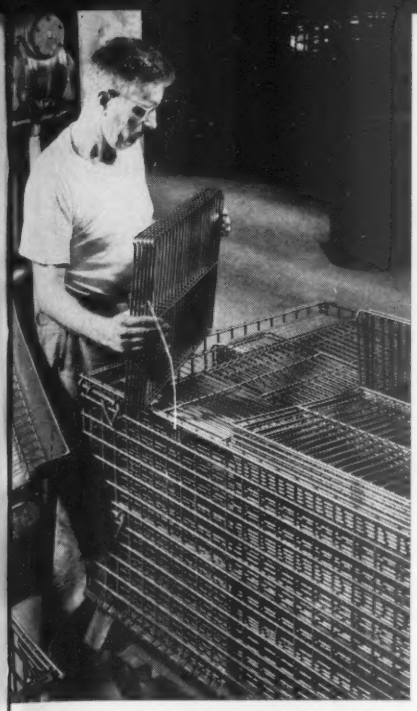




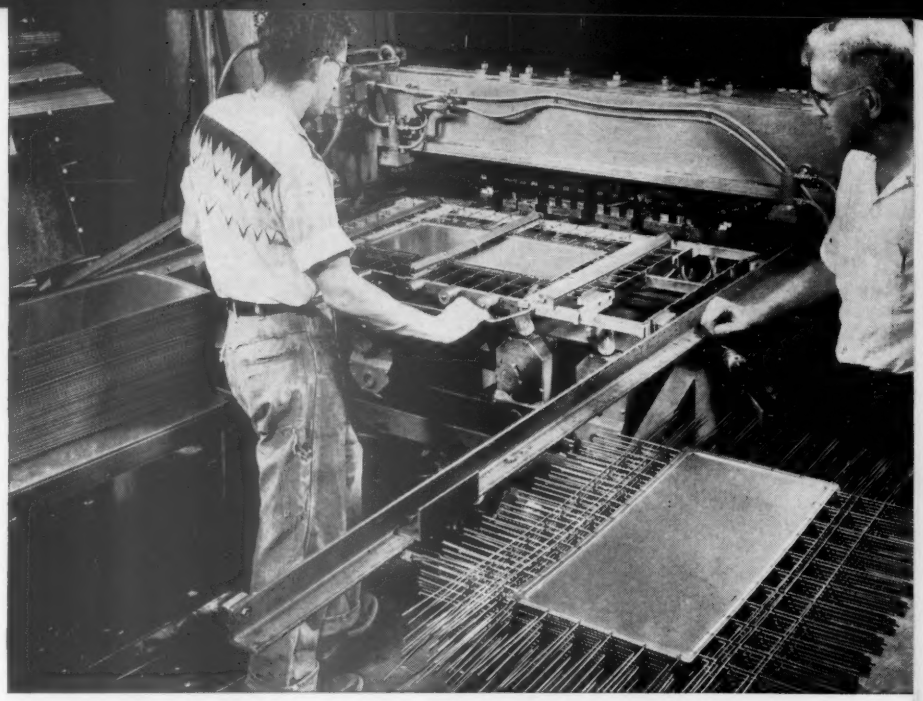
Baskets for a combination refrigerator-freezer enter plating line on conveyor. They are shown here leaving the first bath, an alkaline cleaner, and moving to a clear water rinse. A total of 15 immersions are given these baskets in the process of plating them with a .0005 inch coating of zinc. Below: The excellent surface required for plating is shown in the Pittsburgh Steel wire stockpiled at Bauer Bros. Co. in its Springfield, Ohio, wire division.

Bauer Bros. Gets Extra Clean Wire For Fully Automated Plating Lines

Defect-free Finish of Pittsburgh Steel Co. Wire Eliminates Costly Surface Preparation



This machine was designed and built by Bauer Bros. own personnel to speed the efficient production of racks, seen here coming off the end of the unit.



On this automatic multi-welder, design-specified by William Cannell, right, Bauer Bros. Co. master mechanic, a total of 288 different combinations of welds can be made. Here the operator is welding wire to a solid bottom basket for use by a major appliance manufacturer.

Bauer Bros. Co. demands, and gets, from Pittsburgh Steel Company extra smooth, clean, bright wire which can go into plating lines without any expensive surface preparation.

This is only possible with wire that has an extremely clean, defect-free surface.

Bauer Bros. Co. keeps its Springfield, Ohio, plant's automated plating line running smoothly with consistently excellent results.

The Wire Division of Bauer Bros. Co. fabricates wire shelves, racks and baskets for refrigerators, freezers, ovens and other appliances made by virtually every major appliance manufacturer.

Bauer Bros. buys coils of wire which it cuts into proper lengths, straightens and then forms into finished products on automatic shaping and welding machines, many of which were designed by Bauer Bros. personnel.

On these machines, Pittsburgh Steel's bright basic wire gets its first test. Good grain structure gives the wire ability to take severe bending without ripping or tearing. Uniform hardness from coil to coil and from shipment to shipment speeds production and holds down rejects.

• **Meets Customer's Demands**—On a completely automated plating line, Pittsburgh Steel wire meets Bauer Bros. demands for freedom from pits, seams and porosity.

So, Pittsburgh Steel wire helps Bauer Bros. Co. two ways:

1. More economical production on automatic machines and on plating lines.

2. Improved appearance of the final product adds to salability.

Bauer Bros. Co. can plate its wire products with any of these coatings: A combination of copper, nickel and chrome; zinc, clear or colored lacquer, and plastic (the new Corvel Fusion Bond process).

Products come to the plating line on an overhead conveyor directly from the Fabrication Department. Without any stops, the conveyor immerses products in a series of tanks on the plating line. In zinc plating, pictured here, baskets are dipped in a total of 15 tanks without a halt and without the intervention of a human hand. Drying and baking complete the plating cycle.

On these baskets, destined for use in a new combination refrigerator-freezer made by one of the country's largest appliance manufacturers, the zinc coating never falls below .0005 inch.

After plating, coatings are laboratory checked for porosity, density and resistance to wear and corrosion. In one test, products are enclosed in a salt air immersion chamber where temperature is maintained at 100 degrees F. and humidity at a sweltering 100 percent. A five percent salt solution gives the zinc a rugged workout.

Standards like these, rigidly maintained, call for the best in wire. The wire must be the ultimate in cleanliness, smoothness and uniformity. Pittsburgh Steel wire meets these specifications day in and day out.

Like Bauer Bros. Co., you also can get production economies and a more salable product from the use of Pittsburgh Steel's basic wire. Whatever you make from any type of manufacturers wire—from nails to precision springs—let a Pittsburgh Steel representative show you what Pittsburgh Steel quality and service can do for you. You can start benefiting today by getting in touch with the nearest district sales office.

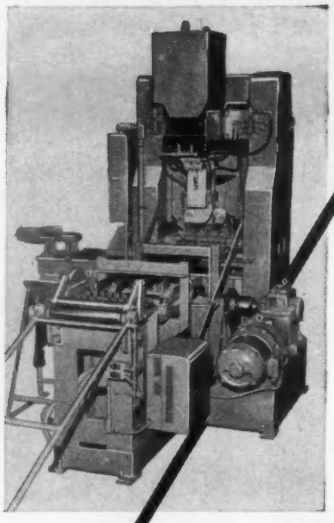
Pittsburgh Steel Company

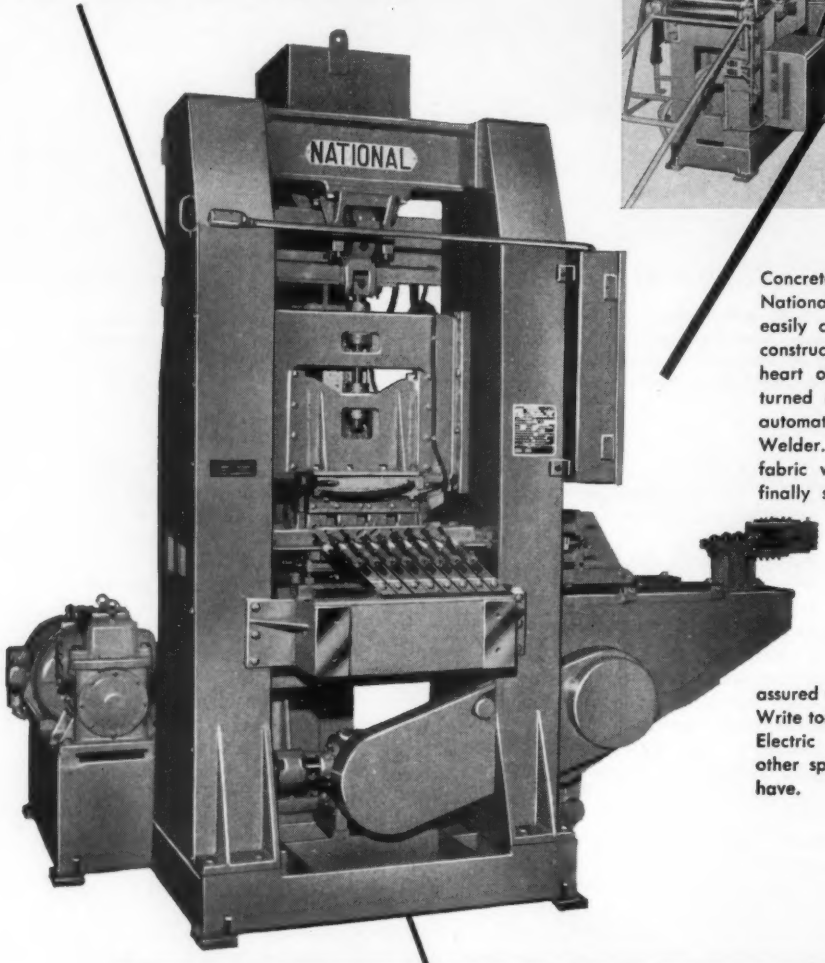
Grant Building • Pittsburgh 30, Pa.

District Sales Offices

Atlanta	Cleveland	Dayton	Los Angeles	Pittsburgh
Chicago	Dallas	Detroit	New York	Tulsa
		Houston	Philadelphia	Warren, Ohio

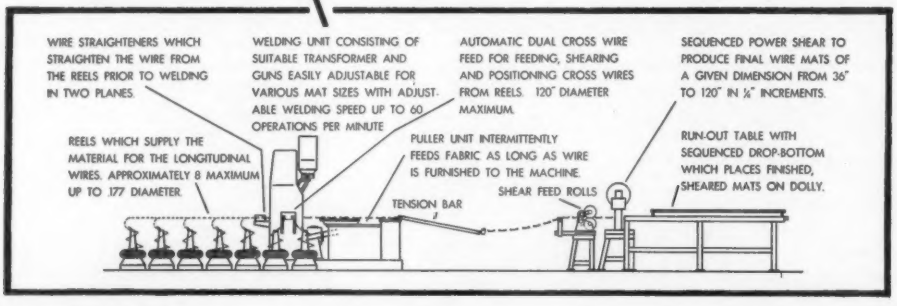
NATIONAL
Electric machine
automatically feeds, welds, and stacks wire mesh for concrete plank





Concrete Plank, with wire mesh welded by a National Electric machine, is lightweight, strong, easily cut, and is solving many floor and roof construction problems in many installations. The heart of Concrete Planking, the wire mesh, is turned out at the rate of 60 feet per minute automatically by National Electric's Wire Fabric Welder. Starting with coils of line wire, the wire fabric welder first straightens, then welds and finally shears rectangular mats to the required size. After shearing, the top of the shear table divides and the mats fall on to a dolly, ready for use in Concrete Plank construction.

Profitable production, amazing savings in time, labor and cost-per-weld on any volume welding job, is assured with National Electric Automatic Welders. Write today for complete information on National Electric Automatic Wire Mesh Welders or any other special or standard welding job you may have.


WIRE STRAIGHTENERS WHICH STRAIGHTEN THE WIRE FROM THE REELS PRIOR TO WELDING IN TWO PLANES.
WELDING UNIT CONSISTING OF SUITABLE TRANSFORMER AND GUNS EASILY ADJUSTABLE FOR VARIOUS MAT SIZES WITH ADJUSTABLE WELDING SPEED UP TO 60 OPERATIONS PER MINUTE
AUTOMATIC DUAL CROSS WIRE FEED FOR FEEDING, SHEARING AND POSITIONING CROSS WIRES FROM REELS. 120" DIAMETER MAXIMUM.
SEQUENCED POWER SHEAR TO PRODUCE FINAL WIRE MATS OF A GIVEN DIMENSION FROM 36" TO 120" IN ½" INCREMENTS.
REELS WHICH SUPPLY THE MATERIAL FOR THE LONGITUDINAL WIRES. APPROXIMATELY 8 MAXIMUM UP TO .177 DIAMETER.
PULLER UNIT INTERMITTENTLY FEEDS FABRIC AS LONG AS WIRE IS FURNISHED TO THE MACHINE.
SHEAR FEED ROLLS
RUN-OUT TABLE WITH SEQUENCED DROP-BOTTOM WHICH PLACES FINISHED, SHEARED MATS ON DOLLY.
TENSION BAR

51

NATIONAL Electric welding machines co.
1880 N. TRUMBULL STREET
BAY CITY, MICHIGAN

25 YEARS EXPERIENCE DESIGNING AND BUILDING: SPECIAL & STANDARD • AIR • HYDRAULIC • MOTOR DRIVEN • SPOT • PROJECTION • SEAM • BUTT • FLASH • RESISTANCE WELDERS • PRODUCTION FIXTURES FOR ALL TYPES OF AUTOMATIC ARC WELDING.

NATIONAL

(COLD ROLLED)

WIRE

...Ferrous or Non-ferrous,
in Coils or Straight Lengths

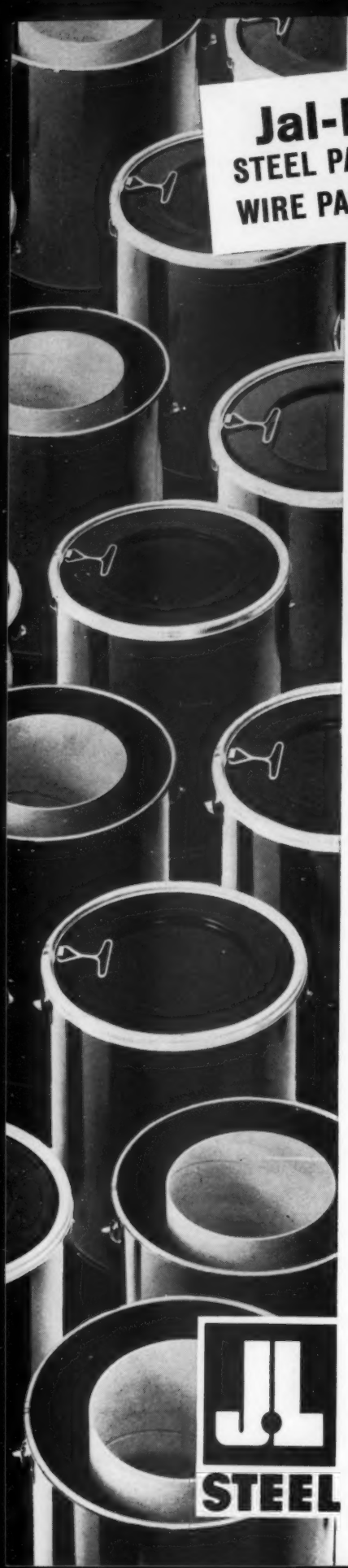
- Round Edge Flat Wire
- Square Edge Flat Wire
- Keystone Shaped Wire
- Oval Wire
- Half Oval Wire
- Half Round Wire
- Special Shaped Wire
- Spring Washers
- Retaining Rings

Complete Metallurgical Service

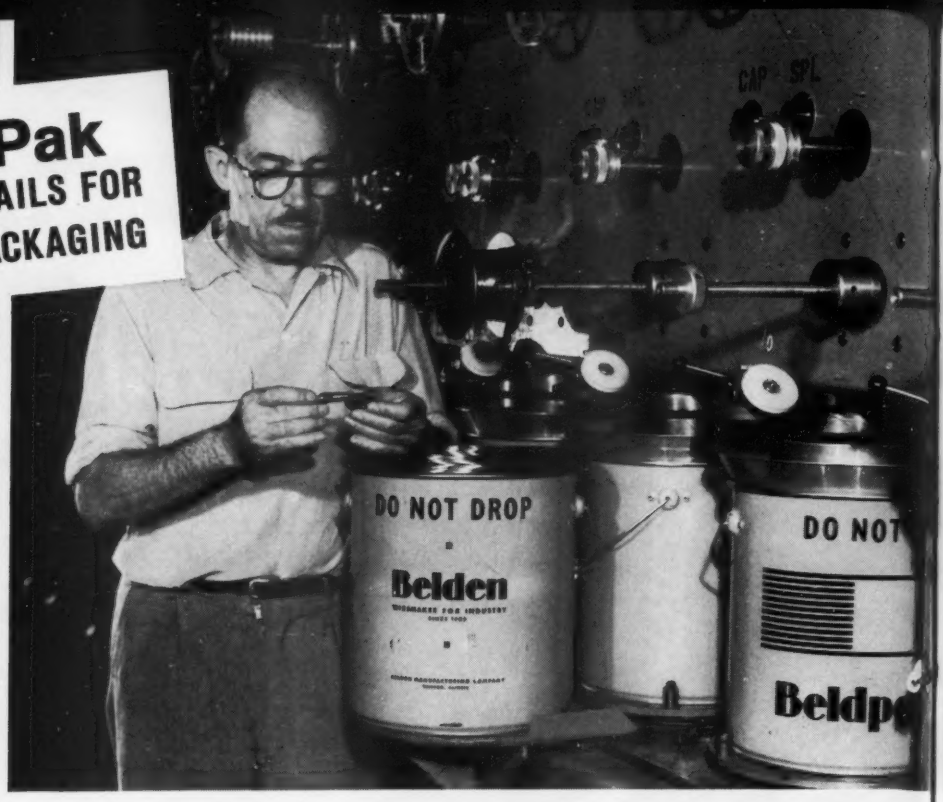
The NATIONAL LOCK WASHER COMPANY

Precision Shaped Wire Division

NEWARK 5, NEW JERSEY MILWAUKEE 2, WISCONSIN



Jal-Pak
STEEL PAILS FOR WIRE PACKAGING



"J&L DISPOSABLE PAIL CUTS OUR WIRE HANDLING COSTS"

...states Belden Manufacturing Company

"These Jal-Pak pails eliminate costly spools and reels in wire handling," reports the Belden Manufacturing Company, Chicago. "There is no initial spool investment, return problem or involved bookkeeping." Belden uses the name Beldpak for Jal-Pak pails. They use them for 14 to 30-gauge wire in 100 pound quantities.

Jal-Pak pails, a unique Jones & Laughlin product, feature a specially rolled smooth side seam that prevents damage to wire and permits optimum winding speeds. You get the protection of steel in shipment and storage. The lower investment, no deposit, no return, save time and money in production operations.

Jal-Paks are service-proved in handling brass, copper, steel, aluminum, stainless steel, welding and soldering wires. For complete information on how Jal-Paks can help you increase production and sell more wire, contact your J&L Container Division representative or write direct to Jones & Laughlin Steel Corporation, 405 Lexington Avenue, New York 17, N.Y.

Belden Manufacturing Co., Chicago, utilizes machines that can handle 24 wires in four sizes with two coats of insulation and simultaneously reel them into 12 rotating 100-lb. Jal-Pak pails. No spools or reels are required.

Jones & Laughlin Steel Corporation
CONTAINER DIVISION
405 LEXINGTON AVENUE, NEW YORK 17, NEW YORK

J&L STEEL

SWIFT'S FLEXAL 2

Swift Development opens up New Opportunities for ANTI-FRICTION ACTION

Flexal² represents a family of "light" metallic stearates which were developed specifically to provide the metal processing industry with a highly heat resistant, water insoluble* processing lubricant.

They have exhibited excellent, effective and economical service life as anti-friction agents, are extremely uniform in composition and highly stable in storage and in use. Their versatility makes The Flexal² family highly adaptable to specific processing requirements.

Why not look over the general specifications with *your specific process* in mind? Our success with this dramatic new family may open a new avenue of ANTI-FRICTION ACTION for *you*. Write for details: SWIFT & COMPANY, Soap Department, 4115 Packers Ave., Chicago 9, Ill.

To Serve Your Industry Better

Swift
104TH YEAR

GENERAL PROPERTIES

CHEMICAL

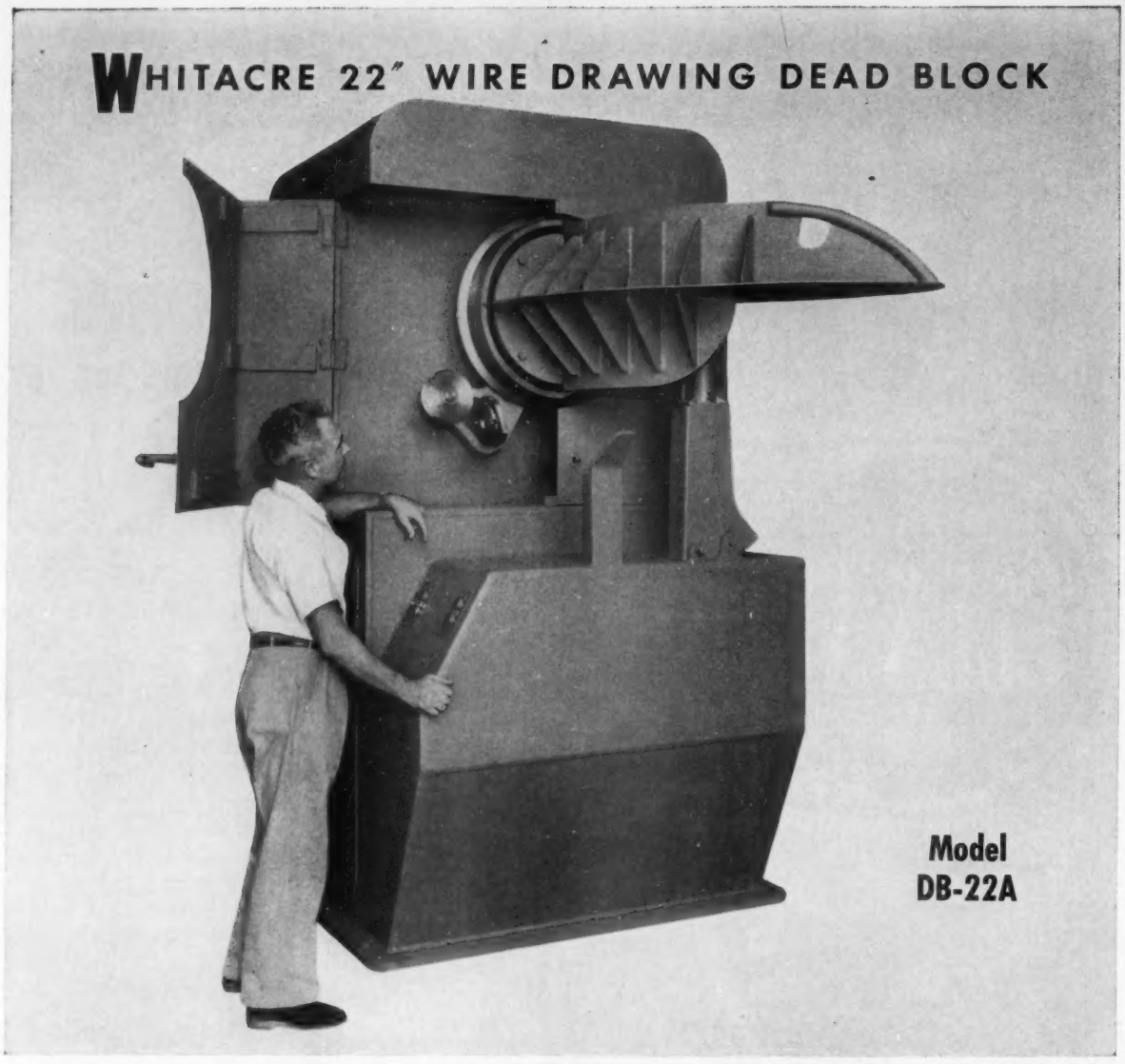
moisture—from 1% to 3% max.
titer range—10° C to 60° C
iodine number—max. to 95
melting point—150° F to 800° + F
storage life—completely stable
molec. weight—(approx.) 288 to 700

PHYSICAL

form—amorphous to powder
color—gray to white
odor—neutral
*solubility—versatile; Flexals can be either soluble or insoluble in water or solvents, depending upon need.

S-48-M

WHITACRE 22″ WIRE DRAWING DEAD BLOCK



Model DB-22A

Continuous Production—Efficiency Approaching 100%

Gives you these advantages

Continuous increased production achieved by: • No down time for stripping • Permits packaging into stationary container or uninterrupted palletizing on stems • No tangling nor snarling from handling • Design simplicity. No back-gearing nor similar mechanisms • Greatly reduced floor space requirements • Dies in supplying drawing machine can be changed without stopping dead block • Accumulation type machines can be "run down" without stopping dead block • Continuous inspection and sampling • Breaks welded in production — low scrap loss • Increased production with lessened operator fatigue • Maintenance eliminated except for occasional lubrication of four main bearings and two motor bearings • Dead block can be located anywhere with wire literally piped from wire drawing machine • Extra large packages for in-process wire • Greatly reduced handling and in-plant transportation costs • Low capital investment.

OTHER MODELS AVAILABLE

16″ Wire Drawing Dead Block, Model DB-16A • 26″ Wire Drawing Dead Block, Model DB-26A • Combination 16″ and 22″ Galvanizing or Tinning Dead Block Take-ups, Model GB-2216A • 26″ Heavy Wire Galvanizing or Tinning Dead Block Take-up, Model GB-26B.

Write Today For Specifications And Name Of Nearest Distributor

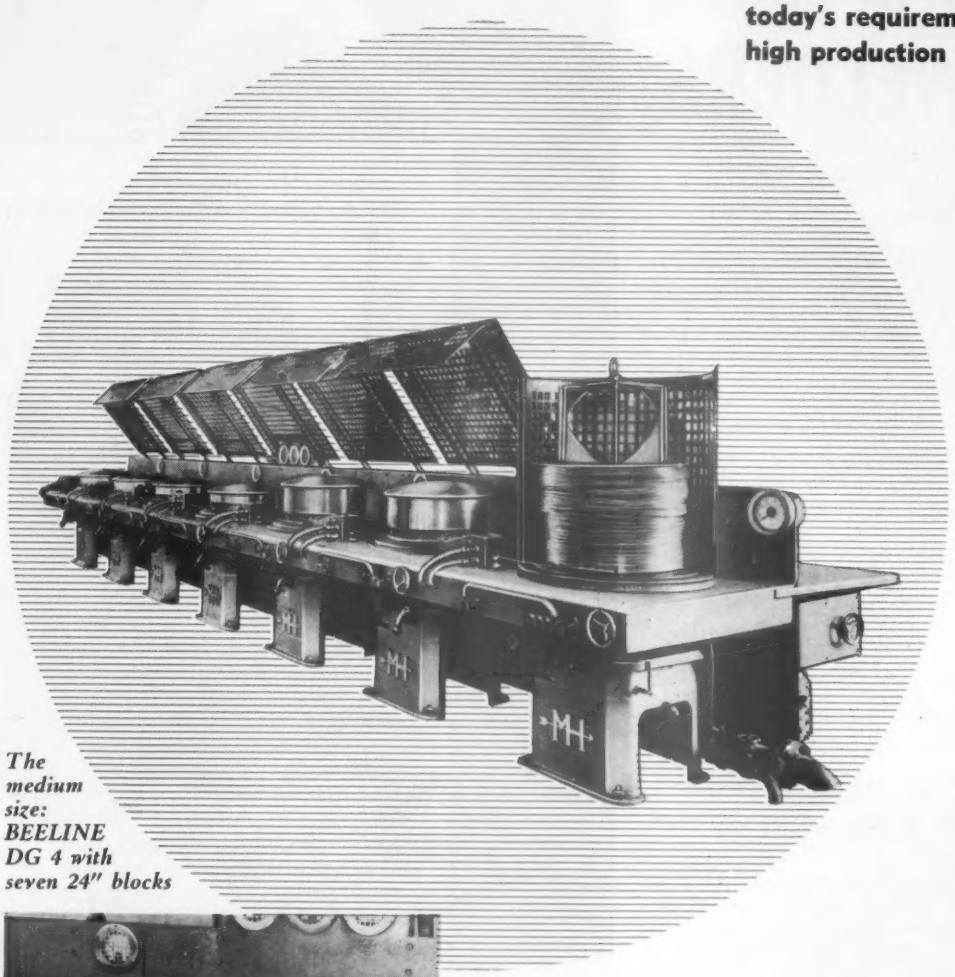
WHITACRE ENGINEERING & MANUFACTURING COMPANY

5649 ALHAMBRA AVENUE • LOS ANGELES 32, CALIFORNIA • CAPITOL 5-2476

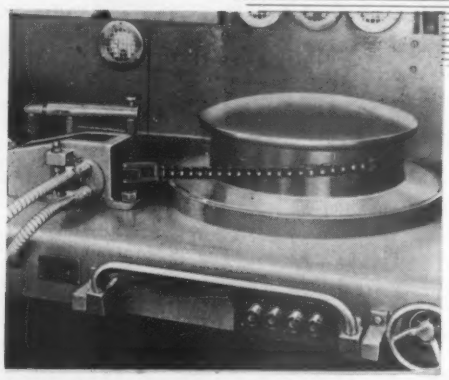
WHITACRE

THE BEELINE

Designed and built to meet today's requirements for trouble-free high production wire drawing



The medium size: BEELINE DG 4 with seven 24" blocks



Safe pulling-in at slow speed

MORGÅRDSHAMMAR

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CABLE: Morgardshammar, Ludvika.
Telephone, 0240-71100

U.S. OFFICE **MH. MACHINES**
19002 LOMOND BLVD.
CLEVELAND 22, OHIO
TELEPHONE: WYoming 1-5830

YOU DON'T NEED A MASTER MECHANIC TO OPERATE MICRO-WELDERS

That's what

an old Mill Superintendent told us when we asked "What do you like best about Micro-Welders?"

He went on to say that unskilled help at his plant quickly learn how to make good, clean welds on our Micro-Welders.

We don't have to tell YOU how important Micro's Ease-of-Operation is on today's uncertain labor market.

Shop Superintendents also Praise Micro-Welders for Durability, Efficiency, Adaptability and low cost of Maintainance.

ask the firms that use micro-welders

For instance, our Model "J" Type Automatic Butt Welders are vital cogs in the plants of:

United States Steel • Steel Company of Canada • Simplex Wire and Cable • Nehring Electrical Works • Mid-States Steel and Wire • Laclede Steel • Kennecott Wire and Cable • Kaiser Aluminum • Jones and Laughlin • International Nickel • B. F. Goodrich Company • B. Greening Wire Company • Copperweld Steel • Continental Steel • Broderick and Bascom Rope Company • Bridgeport Brass • Bethlehem Steel • Belden Manufacturing Company • American Chain and Cable.

MICROMETER PRECISION MICROWELD TRADE MARK REGISTERED

model "J" type
automatic butt welders for welding steel

available in three models:
J-45-S, J-5-S and J-6-S
for welding high and low carbon STEEL wire, sizes from .060" to .375".

The welding cycle on "J" models is automatically completed by one down stroke of the foot pedal. Stock being welded is clamped, contact is made with welding switch and upset pressure on the weld simultaneously achieved.

Included: Annealing dies, filing vise, handshears and 4-wheel truck mounting.

MICRO PRODUCTS COMPANY

20 NO. WACKER DRIVE
CHICAGO 6, ILLINOIS
TELEPHONE STate 2-7468

KEYSTONE QUALITY...

Quirk DESIGN

make the strongest milk crates ever built!

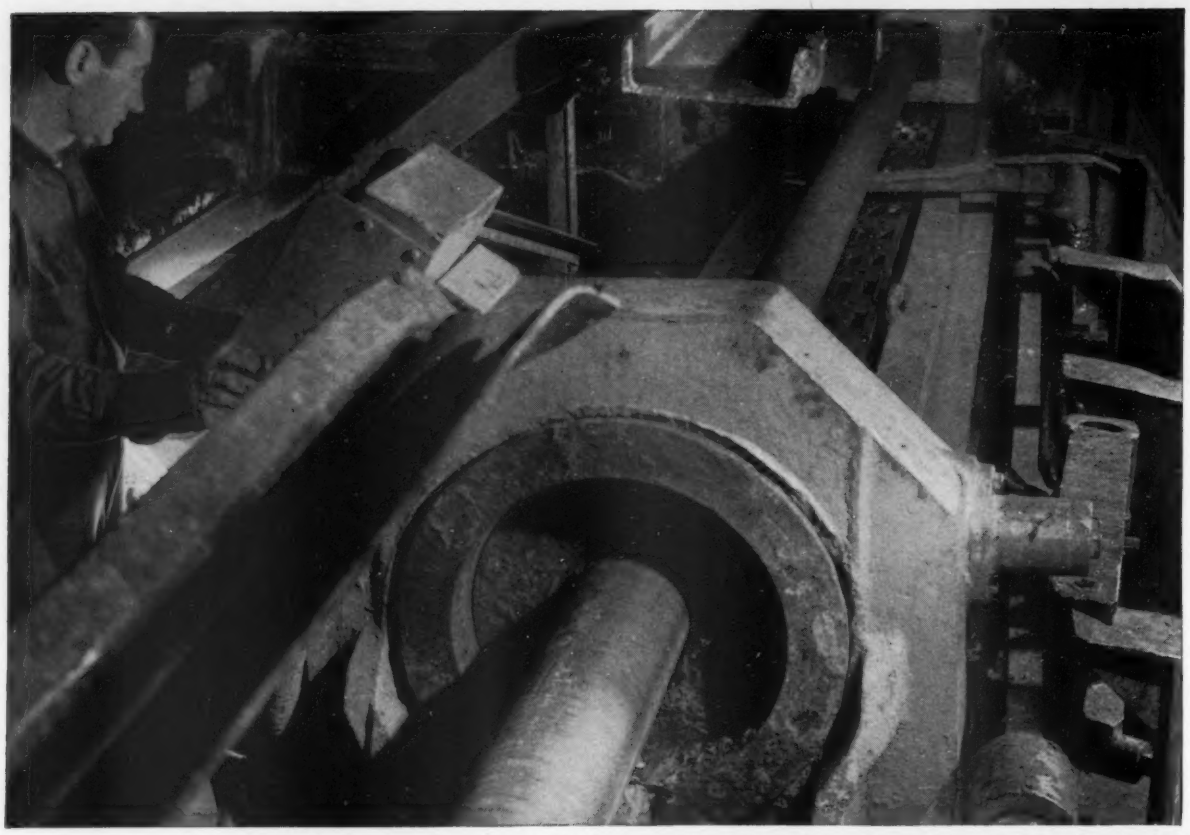
How important is wire in the manufacture of milk crates? "Plenty!" says Casson Butcher, General Manager, Quirk Manufacturing Company, Cudahy, Wis. Here's why Quirk uses Keystone Galvanized Cold Rolling Quality Wire 100%.

- Heading quality—Quirk Bottle Saver Crates use patented double headed rods to brace the crate and prevent loosening of the bottom, corner and side channels. Keystone Wire serves this purpose perfectly.
- Uniform, zinc coating must resist daily immersion in chemical baths at the dairies, yet adhere tightly and avoid flaking from the cold rolling operation. (Flattened wire gives the necessary smooth surface for paper carton crates.)
- Weldability—clean silver brite galvanized surface on specially developed analysis of homogenous steel produces strong uniform welds.
- Easy forming—Quirk Bottle Saver Crates require high protective wire loops with slight spring action. Keystone cold rolling quality wire has the correct temper and stiffness to properly form with ease, yet retain the spring required for rough handling.

This is how another manufacturer builds a quality product —and Keystone Wire helps make it easier and more practical. It may be the answer to many of your quality control problems, too. For complete information, call your Keystone Representative. Our metallurgical staff is anxious to help solve your wire problems.

Keystone Steel & Wire Company, Peoria 7, Illinois

KEYSTONE WIRE FOR INDUSTRY



Rough casing (foreground) hits Carboloy die shoulder at 20 fpm. But before the casing has gone more than 2 feet, it is traveling 50-60 fpm . . . a speed not possible with steel dies.

In Pittsburgh Steel Company's Allenport Works . . .

CARBOLOY® CARBIDE DIES REPLACED STEEL DIES . . . AND DIE COSTS FOR DRAWING 7" CASING DROPPED 80%

To reduce costs, Pittsburgh Steel installed Carboloy dies to draw 7" oil well casing. The result: die costs have been cut 80%, product quality improved, and production increased.

Each Carboloy die produces an average of 400,000 feet of 7" casing. Steel dies on the same operation averaged only 3,200 feet. In dollars and cents this adds up to 320 feet of casing delivered for each dollar spent on Carboloy carbide dies against only 64 feet from a steel die dollar.

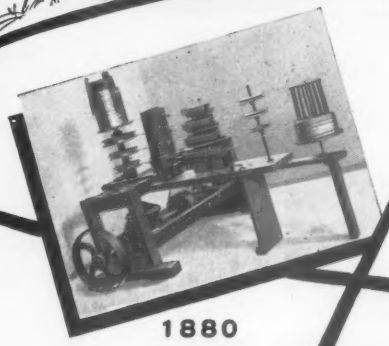
Product quality has been improved, too, because the extreme hardness and smoothness of the carbide surface prevents scoring . . . gives a better as-drawn finish. As a result, rejects have been reduced. And because there have been no failures in service with Carboloy dies, rejected casing due to die failure have been eliminated.

Whether you are flattening, drawing, extruding, or heading, a Carboloy cemented carbide die product can mean savings for you. For more information, in-plant technical assistance, or a copy of the new Carboloy Die Engineering Manual, write: *Metallurgical Products Department of General Electric Company, 11171 E. 8 Mile Street, Detroit 32, Mich.*

CARBOLOY®
CEMENTED CARBIDES

GENERAL ELECTRIC

HERBORN

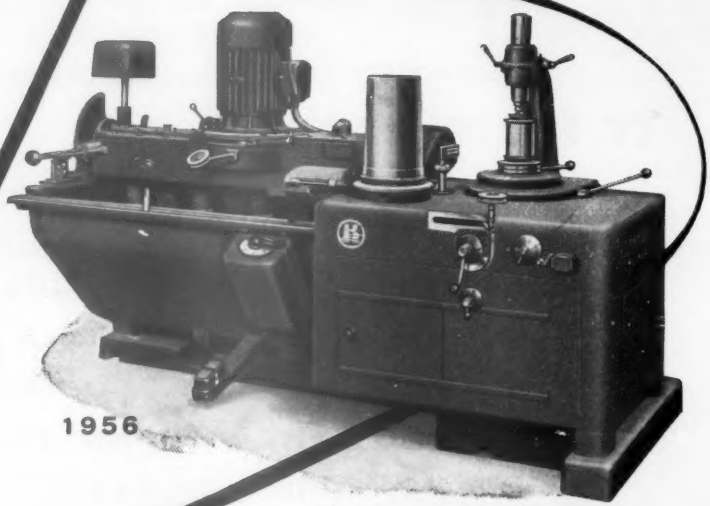


1880

A Long Way

leads from the
first wet-drawing machine

to the modern
High-Production
Multiple Wire
Drawing Machines
Operating under
the "HERBORN"
Submerged System



1956

The Invention and
Development of the "Submerged
System" Wire Drawing Machines
is inseparably connected with
the name "HERBORN."

Please send your inquiries to:

MASCHINENFABRIK HERBORN BERKENHOFF & DREBES A.-G. **HERBORN/DILLKREIS** GERMANY

Sole Representative in the U. S. A.:

KURT ORBAN CO., Inc., 34 Exchange Place, JERSEY CITY 2, N. J.

Sole Representative in Canada: PAUL REICHER, P. O. Box 127, Willowdale, Ont., Canada.

"Tough-to-make"

Cold-Headed Products like these . . .

- Tubular Rivets (Punch Extruded).
- Non-threaded, multi-diameter, head and shoulder parts, drilled or not drilled.
- Washer and binding head screws with rolled threads.
- Special design fastenings and other small parts of intricate shape, with or without requirements for drilling or threading.

. . . become "routine" with

SCOVILL

EXTRUDED

Cold-heading WIRE

(Cartridge Brass, 70%)

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY

IT ELIMINATES

1. **OUT-OF-ROUND HEADS**
2. **INCOMPLETE FILLING-OUT OF HEADS AND SHOULDERS**
3. **ROUGH "ORANGE PEEL" EFFECT**
4. **UNSOUND HEADED PARTS**
5. **RED STREAKS AND STAINS**
6. **NON-UNIFORM FLOW**

SCOVILL

Send for new folder.

Scovill Cold-Heading Wire is extruded from CONTINUOUS-CAST brass billets by the hot extrusion process, then cold-drawn and annealed in accordance with closely controlled mill procedures.

CONTINUOUS CASTING produces *more uniform metal* than any other process, both in chemical composition and in freedom from casting flaws or other variations.

Scovill has standardized on *Cartridge Brass,* **70% for wire to be used in cold-heading operations. This alloy has a 5% HIGHER COPPER CONTENT than is generally found in brass cold-heading wire and is more ductile.**

Prove this on your next wire order. Let us help you specify the proper closely controlled Scovill temper to produce more nearly perfect headed brass parts . . . whether you require "flow" characteristics for heading, or "flow" plus essential rigidity for secondary machining.

SCOVILL MANUFACTURING COMPANY, Mill Products Division

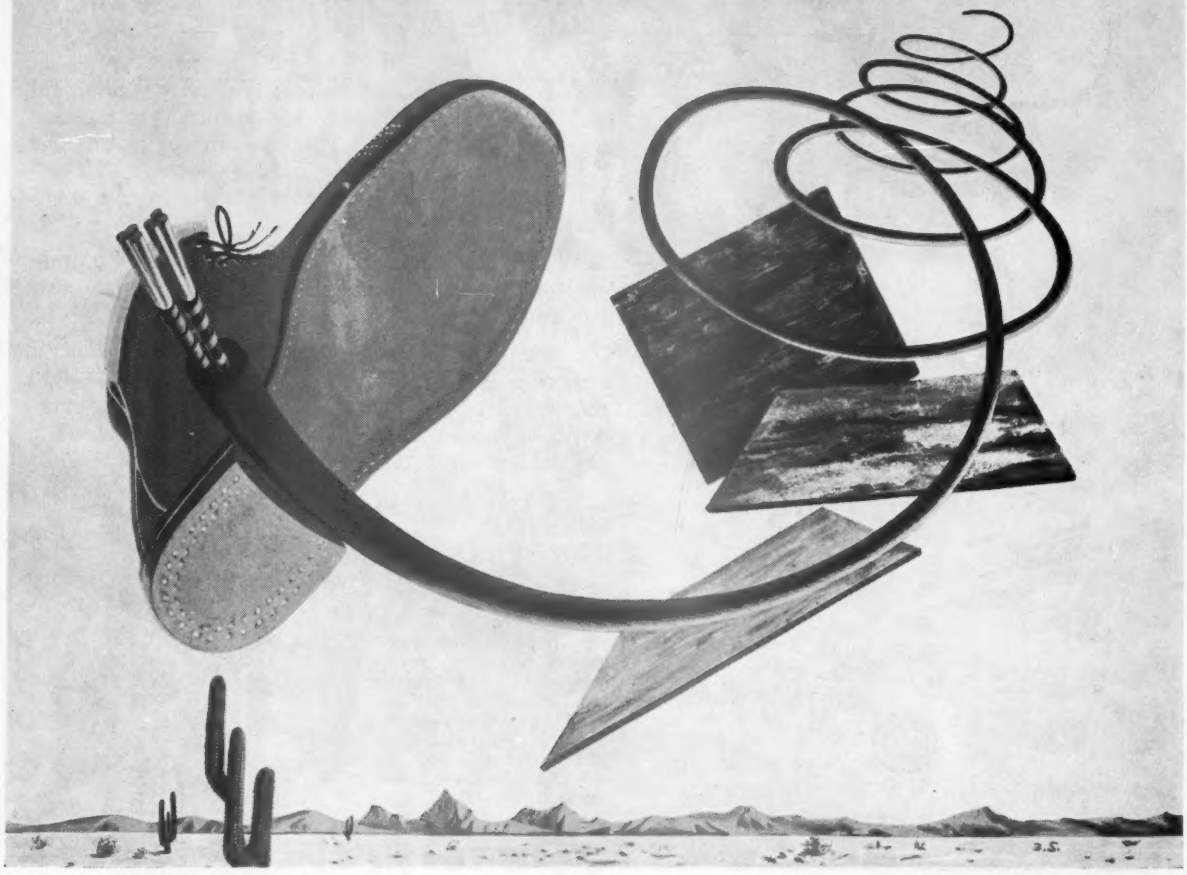
99 Mill Street, Waterbury 20, Connecticut. Phone PLaza 4-1171.

129C58

NAUGAPOL K-50

SPECIALLY-PROCESSED SBR POLYMER

...a new dry rubber blend



Now a new dry rubber blend has been added to the Naugatuck line to give you a still wider choice of "wire grade" rubbers to meet your product needs.

A special masterbatch of high styrene resin and low-temperature polymerized synthetic rubber, Naugapol® K-50 offers unusually good processing characteristics together with the "dryness" and high-cured physicals for which all Naugapols are noted.

Primarily designed for use with additional butadiene-styrene copolymer—for such products as shoe soles, floor tile, and wire insulation—Naugapol K-50 is the only blend of this kind available which is suitable for wire insulation.

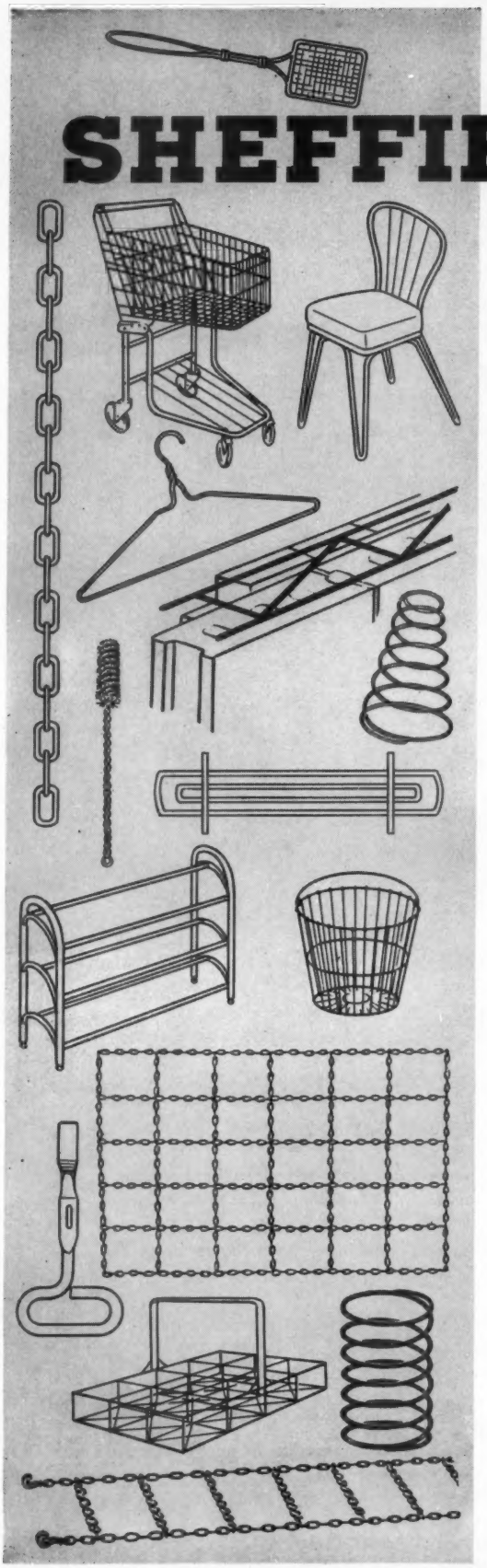
Try Naugapol K-50—available in pellet form—wherever you require high dielectrics, low-ash, easy processing. For detailed information on Naugapol K-50, the Naugapols generally, or still other special grades of synthetic rubber, write us today.

Naugatuck Chemical

Division of United States Rubber Company 1241 N Elm Street Naugatuck, Connecticut

US RUBBER

Rubber Chemicals • Synthetic Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latices • CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario • CABLE: Ruberport, N.Y.



Why manufacturers use

SHEFFIELD WIRE

in more than 2,000 quality products

Manufacturers and fabricators depend on Sheffield Wire for unvarying quality and accuracy in meeting their wire specifications. They are sure of getting the RIGHT wire—and getting it fast—because of Sheffield's advanced quality controls and strategic plant locations.

We're old hands at helping customers solve wire problems—with results that speed production, cut costs and improve products.

Let our metallurgists and wire specialists analyze your wire uses. We'll not only come up with the right wire for you, but also may be able to recommend more economical ordering units. This service is yours for the asking. Just call your nearest Sheffield office.

SHEFFIELD KONE PAK*

gives you in one continuous spool the equivalent of 2 to 40 ordinary coils of wire. It gives longer continuous runs, less down time, and can cut scrap losses as much as 90%. The Kone Pak is mounted on a disposable wooden pallet, and can be packed in streamlined cardboard container if desired.

SHEFFIELD ARMCO WIRE PRODUCTS

Coiled Wire

Annealed—#20 (.035" ga.) through 1"

Galvanized—#20 (.035" ga.) through #4 (.225" ga.)

Bright—#20 (.035" ga.) through 1"

Straightened and Cut Wire

Annealed—#20 (.035" ga.) through ¾"

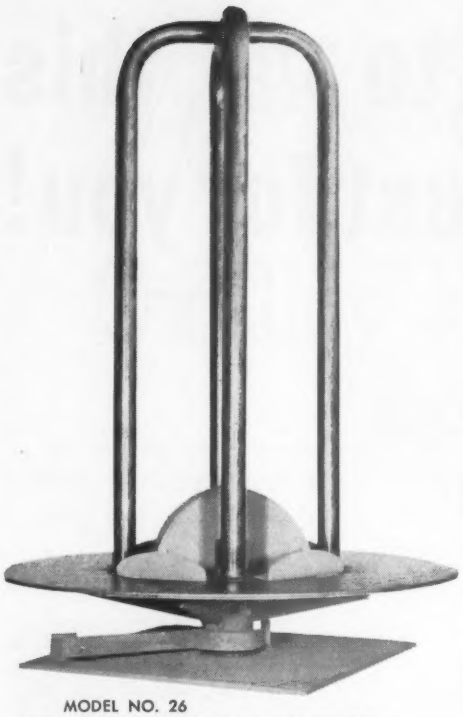
Galvanized—#20 (.035" ga.) through #4 (.225" ga.)

Bright—#16 (.0625" ga.) through ¾"

* Patent Pending

New ALUMINIZED WIRE
16 ga. (.0625") through 6 ga. (.192")
WRITE FOR FREE SAMPLE

SHEFFIELD DIVISION
ARMCO STEEL CORPORATION
SHEFFIELD PLANTS: HOUSTON • KANSAS CITY • TULSA



MODEL NO. 26
WIRE CARRIER MOUNTED ON PAY-OFF REEL

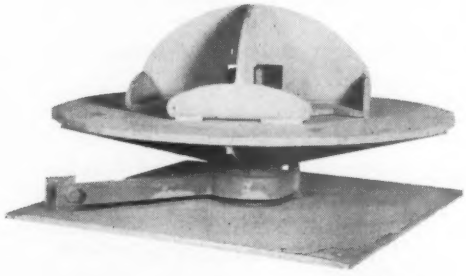
WORKING WONDERS WITH WIRE:

How to reduce changeovers, handling, down-time, scrap-ends 4 to 10 times!

Leading wire producers and fabricators across the country use (and recommend)

NORTHERN INDIANA STEEL'S
HIGH CAPACITY, HEAVY DUTY

WIRE CARRIERS and PAY-OFF REELS



MODEL NO. 26
PAY-OFF REEL

Let us know exactly what your operating needs are. If we don't already have the wire carriers and pay-off reels in stock, we're ready to make up your order as per your exact specification. In any case, we'll be pleased to quote you promptly in the quantities you specify.

They feed more smoothly

Handle 2000# to 4000# coils

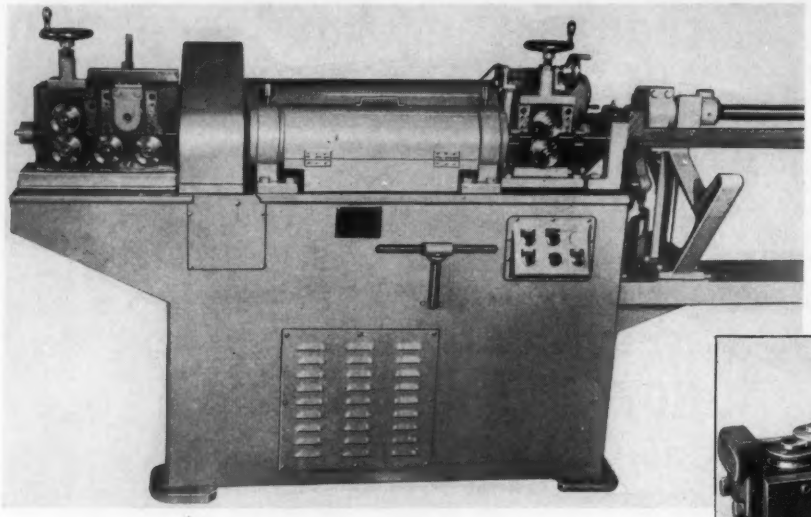
Stack and store easily

And—They're Designed and Produced To *Your* Specifications

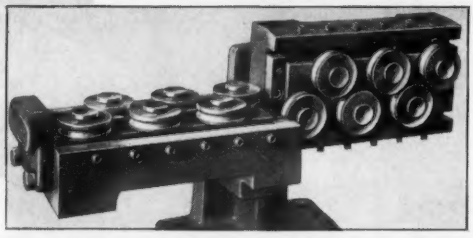
Northern Indiana Steel Supply Co., Inc.

Fabricating Division, Michigan City, Indiana
TELEPHONE TRiangle 4-3241

If you use wire up to 3/8", this new SHUSTER is just for you!



Roll type straightener interchangeable with rotary arbor.



These new SHUSTER wire straightening and cutting machines incorporate new advantages to give you higher production—for less cost. The 2ABV variable speed unit straightens and cuts round wire from 3/16" to 3/8"; the 2ABVF straightens and cuts shape stock up to 1/4" square.

The new machines include an improved, vertical drive 5-roll gear driven preliminary straightening unit, and feed roll housing, both Timken bearing equipped. The new SHUSTER'S can automatically cut lengths up to 14" at the rate of 140 pieces per minute, and provide infinite variable speed within all feed and cutoff ranges. This machine may also be purchased as a constant speed unit (150 f.p.m.).

SHUSTER FEATURES:

1. Higher speed five die straightening arbor, mounted on ball bearings for minimum vibration.
2. Electric trip mechanism on target.
3. Solenoid-operated roll-type clutch.
4. Electric control Panel—one position operation.
5. Totally enclosed feed roll housing and prestraightener with shafts mounted on Timken Bearings. Gears in oil.
6. Electric Brake on clutch shaft.
7. Wide range Reeves Variable Speed. 50 to 200 F.P.M.
8. Wire size range: 3/16" to 3/8" diameter basic wire.
9. Gear driven preliminary 5 roll straightener, mounted in vertical position.

Want more details? Send this coupon today!

Gentlemen:

☐ Please send me complete specifications and prices on the 2ABV-2ABVF SHUSTER.

☐ Send me specifications and prices to meet the following wire straightening requirements: .....

.....

Name .....

Address .....

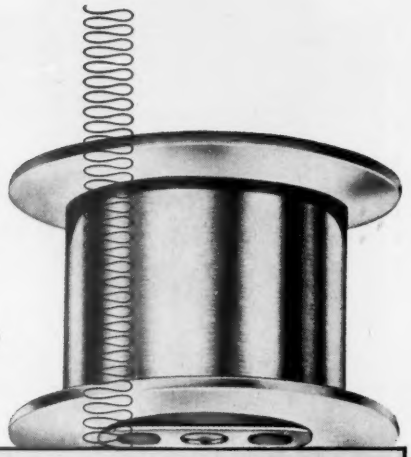
City ..... *State* .....

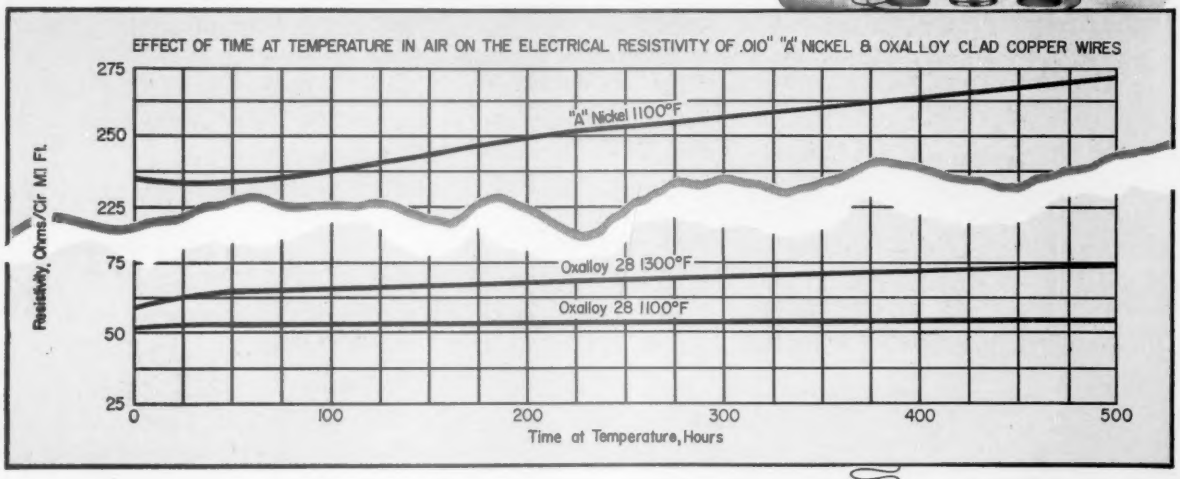
METTLER MACHINE TOOL, INC.

155 W. Adeline Street • New Haven, Connecticut

NEW

Sylvania Oxalloy* 28 Wire...





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- 180° vertical lead-in guide adjustment
- Snaps on both fibre and steel
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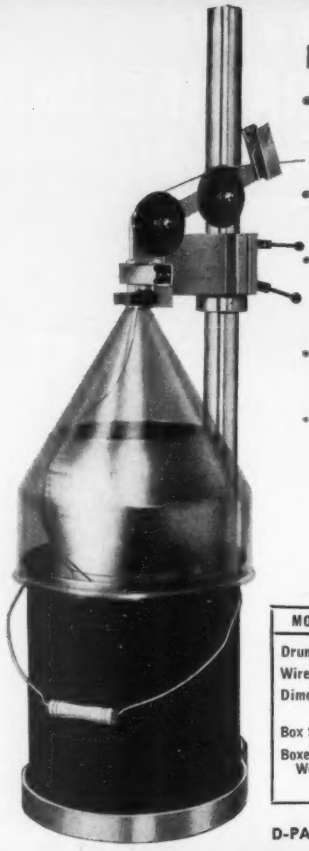
MODEL	D-PAK 40	D-PAK 100
Drum Size	8"	11"-11¼"
Wire Sizes	AWG 27 and finer	AWG 17-30
Dimensions	9" Dia. X 14½" high	11½" Dia. X 16"
Box Size	10" X 10" X 18" high	12" X 14" X 20"
Boxed Weight	5 Lbs.	6 Lbs.

FLOOR TYPE



D-PAK 100-A, *Illustrated*

- Designed for D-Paking of wires at higher speeds with closer control
- Base may be permanently fixed
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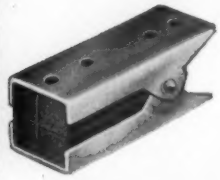
Dual capstans give greater range of tension adjustment

MODEL	D-PAK 40-A	D-PAK 100-A
Drum Size	8"	11-11¼"
Wire Size	AWG 27 and finer	AWG 17-30
Dimensions	9" X 12" X 34" high	12½" X 17" X 43" high
Box Size	10" X 13" X 35"	13" X 18" X 44"
Boxed Weight	20 Lbs.	33 Lbs.

ACCESSORIES



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Net Weight	¼ Lbs.

CORE BALL

- For Use with Floor Type D-Pak

SIZE	BALL 40	BALL 100
Core Diameter	6"	8"
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FRICTION CAPSTAN

- Adjustable Tension
- Precise Control

SIZE	CAPSTAN #1	CAPSTAN #2	CAPSTAN #3
Dimension	4⅜"	3-7/16"	2¼"
Wire Size	10-23 AWG	17-30	24-37
Net Weight	3 Lbs.	1 Lb.	½ Lb.

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- For Use with Attachment Type D-Pak

SIZE	RING 40	RING 100
Core Diameter	6"	8"
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SINCE 1942 BRIDGEPORT 7, CONNECTICUT, U.S.A. INCORPORATED 1951

The Wire Outlook

As the saying goes—"Things are getting better all the time."

While it may be over-simplification, the election results indicate that more liberal spending on the part of Government was wanted and that the union chiefs succeeded in convincing most members that more political advantages were to be secured from the Democratic Party. The first leads to an increasing tempo of inflation and the second leads to socialism. Before things get too far along the old New Deal road to ruin, let us hope that by 1960, the trends will be apparent even to the uninformed who are so easily swayed by demagogues.

Steel and autos, we are glad to report, are the bell-wethers in the upturn. Steel mills have increased production to around 75% of capacity and the reception to the 1959 cars has been most encouraging.

Looking ahead, based upon a survey made by Dun's Review, 8 out of 10 companies expect total sales volume to increase by 28% by 1965 and up to 100% by 1975. The survey embraces the opinions of sixty-six major industrial concerns. Many of them indicate their belief that the South and West will be the areas of greatest development in the next ten years.

Total economic activity in the third quarter of 1958 attained a rate of $440 billions, which compared with the second quarter's $429 billions and the all-time high in the third quarter of 1957 of $446 billions.

As to inflation, wage increases are only an effect of the basic force—deficit spending. Right now, there seems little prospect that any sharp curtailment in Government spending can be achieved. If anything, it will be increased as, both traditionally and by popular mandate, the Democratic majority will spend more of our money.

While conditions are better and will continue to improve, so far as individual businesses are concerned, any over-liberal national policies must bring on a day of reckoning. Our inflation (and therefore high prices) has brought about another disparity—the ratio of exports to imports on steel mill products. In July, according to AISI, we received 171,000 net tons of mill products, against 169,000 tons shipped out, a drop of two-thirds from the preceding year. Of the total imports, nails accounted for 18,000 tons, 7,000 tons more than in July a year ago. Barbed wire and fencing are also large import items.

However, new orders are flowing into business in a rising tide and new orders in September topped those of a year ago. These orders were valued at 26.8 billion dollars. Factory shipments also recorded a sharp increase to 26.7 billion dollars, which was good, considering that automobile shipments could not be included, as most plants were shut down by strikes during September.

Inventory trimming, a major cause of the recession, appears to be at an end. While inventories are not being built up to any extent, larger orders for prompt delivery are being received by product producers. Personal incomes, well ahead of last year, are reflected in increased consumer buying.

In the wire industry, precision spring orders have risen and fabricated wire products are moving well. Fastener makers have been heartened by increased buying. The demand for wire and wire products has increased enough to raise outputs to around 75% of capacity, as compared with 50% a couple of months ago. While wire rod sales are active, deliveries are still about two weeks and merchant wire products are available from stock. Among the items that are moving well are the new screw shank nails and, interestingly enough, umbrella and corset wire, quiet for some time, has picked up nicely. Automotive wire volume, of course, has risen sharply.

Business is good, but not booming. The groundwork being laid now gives every evidence that the recession is a matter of history and that 1959 may set some new records.

Edmund Duval Sickels
EDITOR

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DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 33 DECEMBER, 1958 No. 12

Annealings and Dies in Process Drawing of Wire

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Division of Engineering Research and Development
University of Rhode Island
Kingston, Rhode Island

I. Introduction

Modern process drawing of wire with high speed wire drawing machines requires the evaluation of the minimum number of necessary annealings and dies as well as the precise determination of the die sizes, governed by the following:

(a) The diameters of the wire at base (start) and finish size;
(b) The given tensile strength or hardness of the base and the desired tensile strength or hardness of the finish product;
(c) The maximal stress to which the wire can safely be subjected before rupture.

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The per cent reduction in area is a measure of the straining of the wire during drawing. For many metals the maximum permissible per cent reduction in area or the drawing limit may be much higher for thin sections than for thick. If a heavy gauge is drawn, a material will withstand only limited reductions without rupturing. On the other hand, the same metal can be drawn into very thin wire without intermediate anneals below a certain maximum thickness. This general phenomenon as well as the conditions of the drawing process, which may differ considerably, make it impossible to give general and definite instructions for processing wire. However, within limitations, valuable information can be obtained by tensile testing the metal where the per cent reduction in area at fracture is determined. Knowing the upper limit and staying below a certain safety margin, the annealing steps and dies for processing a certain wire can be evaluated within this limit.

Dr. F. A. Mohrnheim

The author was appointed to his present position in 1957. His previous practical experience as a Metallurgist was acquired in Pforzheim, Germany, Toronto, Canada, and Attleboro, Massachusetts. He received a degree of Doctor in Engineering in 1942 from Stuttgart and was registered as a Professional Engineer in the Province of Ontario in 1954. He is a member of AIME and ASM.

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In the following, a practical basic equation is developed for rapidly calculating the per cent reduction in area in order to show afterwards the slightly more complicated relationship between multiple annealing and drawing steps.

II. Single Wire Drawing

The cross sectional area A of a wire having diameter d is:

$$A = d^2 \pi/4 \qquad \text{Eq. 1}$$

The per cent reduction in area R is calculated by dividing the difference between the cross sectional area of the wire before drawing (base) and the smaller corresponding area after drawing (finish), by the area before drawing.

Using the subscript $_b$ for the base (start before drawing) and $_f$ for the finish state, one can express the per cent reduction in area R, according to its previous definition, as follows:

$$R = (A_b - A_f)/A_b = 1 - A_f/A_b \quad \text{Eq. 2}$$

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The ratio of the areas after finish drawing and before drawing A_f/A_b, is actually the per cent remainder in area after drawing and is the complement for which the symbol C (for complement) is here suggested. R and C mutually complete each other and together constitute the whole, i.e., the original unit. This is expressed is Equations 3 and 4 to which reference is frequently made hereafter.

$$R = 1 - C \quad \text{Eq. 3}$$
$$C = 1 - R \quad \text{Eq. 4}$$

The use of the expression "per cent remainder in area after drawing" is very convenient, as an intermediate step, to find the per cent reduction in area and, moreover, is most useful and practical in calculations for multiple drawing operations, as will be shown later.

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By applying Equation 1 to the definition of C and simplifying, the following practical equation for the per cent remainder in area is found:

$$C = A_f/A_b = (d_f/d_b)^2 \quad \text{Eq. 5}$$

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The per cent reduction in area is then readily found by applying Equations 3 to 5, as expressed in the following:

$$R = 1 - C = 1 - (d_f/d_b)^2 \quad \text{Eq. 6}$$

Notations:

R	= per cent reduction in area
C	= per cent remainder in area
A	= cross sectional area of wire
d	= diameter of wire
Subscript $_b$	= base (before drawing)
Subscript $_f$	= finish (after finish drawing)

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Equations 5 and 6 have been applied by the writer in a logical sequence of steps to an ordinary slide rule for a "Practical Slide Rule Method for Calculating Percentage Reduction in Area in Working and Testing of Rod and Wire[1]. For those who are constantly engaged in drawing processes the aid of graphs [2], or a special slide rule [3, 4] is very useful. Tube making, which is related to wire drawing but slightly more complicated, is explained and evaluated elsewhere by the writer [5].

III. Multiple Wire Drawing

In multiple wire drawing operations a number of drawing passes is applied. One may express the state of drawing by subscripts as follows:

Subscript $_1$ = after 1st drawing pass (single)
Subscript $_2$ = after 2nd drawing pass (single)
Subscript $_3$ = after 3rd drawing pass (single)
Subscript $_n$ = after drawing pass n (single)
Subscript $_f$ = after finish drawing (total)

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The per cent remainder in area after the finish (total) drawing C_f equals the product of the single (individual) per cent remainders in area after each drawing, where the preceding remainder in area each time is considered as the unit; one may express this as follows:

$$C_f = C_1 \times C_2 \times C_3 \ldots \times C_n \quad \text{Eq. 7}$$

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The following example shows the practical application of Equation 7:

Example 1: A wire is drawn three passes, the reduction in area by single pass being 18, 12 and 14 per cents. What is the finish (total) per cent reduction in area?

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Solution:

1. Find the per cent remainders in area for each single pass, by applying Equation 4:

$$C_1 = 1 - R_1 = 1 - 0.18 = 0.82$$
$$C_2 = 1 - R_2 = 1 - 0.12 = 0.88$$
$$C_3 = 1 - R_3 = 1 - 0.14 = 0.86$$

2. Find the per cent remainder in area after finish drawing, using Equation 7:

$$C_f = C_1 \times C_2 \times C_3$$
$$= 0.82 \times 0.88 \times 0.86 = 0.62$$

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3. Find the per cent reduction in area after finish (total) drawing, using Equation 3:

$$R_f = 1 - C_f = 1 - 0.62 = 0.38$$

Answer: The finish reduction in area is 38 per cent.

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IV. Equi-Multiple Wire Drawing

Equi-Drawing is the special case of multiple drawing where each single (1) pass of a certain number of passes performs the same per cent reduction in area. The per cent remainder in area after finish drawing equals the per cent remainder in area after a single pass to the n-th power, which is expressed in the following equation:

$$C_f = C_1^n \quad \text{Eq. 8}$$

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The following example shows the practical application of Equation 8:

Method of Calculating "Final R" in Equi-Drawing

Example 2: A wire is drawn five times, each time 15 per cent. What is the finish per cent reduction in area?

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Solution:

1. Find the per cent remainder in area after a single pass, using Equation 4:

$$C_1 = 1 - R_1 = 1 - 0.15 = 0.85$$

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2. Find the per cent remainder in area after finish drawing using Equation 8:

$$C_f = C_1^n = 0.85^5 = 0.443$$

★ ★ ★

3. Find the unknown per cent reduction in area after finish drawing, using Equation 3:

$$R_f = 1 - C_f = 1 - 0.443 = 0.657$$

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Answer: The finish reduction in area is 65.7 per cent.

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An important problem in equi-multiple drawing of wire is to calculate and set forth a pass plan for a given wire (base) to be drawn to a desired size (finish) by a series of dies where each die performs the same per cent reduction in area. The latter is called in shop language "Percentage Draft Per Hole", or "P. D. H." In order to obtain optimal physical properties and for economy reasons the per cent reduction in area per each hole, (P. D. H.), should be the maximum permissible depending on the alloy and the specific drawing conditions. The single per cent reduction in area can be derived at in the following way: By rearranging terms of Equation 8, one obtains the per cent remainder in area after a single pass, i.e.:

$$C_1 = \sqrt[n]{C_f} \qquad \text{Eq. 9}$$

The per cent reduction in area after the finish drawing is then according to Equation 3:

$$R_f = 1 - C_f \qquad \text{Eq. 10}$$

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Using Equations 3 and 9 one obtains the per cent reduction in area after a single pass, expressed as follows:

$$R_1 = 1 - C_1 = 1 - \sqrt[n]{C_f} \qquad \text{Eq. 11}$$

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The determination of higher powers and roots can be made in many ways depending upon individual skill. An easy method to solve such problems with an ordinary slide rule has been shown [1]. However, for high speed multiple wire drawing, a higher degree of accuracy is needed. The classical approach is the use of log tables. A refined slide rule with scales of the logarithms of the cologarithms of decimal fractions such as the Log Log Duplex Decitrig[6] slide rule, provides an advanced and direct method to find powers and roots and is recommended.

Method of Calculating "Individual R's" in Equi-Drawing

In equi-drawing one often has to find individual equal per cents reduction in area to distribute a given final per cent reduction in area among a given number of equal passes.

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Example 3: 62 per cent reduction in area should be equally distributed among six drawing operations (passes).

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Solution:

1. Find per cent remainder in area after finish drawing, using Equation 4:

$$C_f = 1 - R_f = 1 - 0.62 = 0.38$$

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2. Find per cent remainder in area after a single pass, using Equation 9:

$$C_1 = \sqrt[n]{C_f} = \sqrt[6]{0.38} = 0.851$$

The solution can be found with log tables or with an ordinary slide rule, by using the D and L scales, when one knows the use of logs, as shown for this example in the following:

$$\log C_f = 1/6 \log 0.38 = 1/6\ (9.5798\text{-}10)$$
$$1/6\ (59.5798\text{-}60) = 9.9299\text{-}10$$
$$C_f = \log 9.9299\text{-}10 = 0.851$$

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The result can also be found, by using a Log Log Duplex Decitrig slide rule as follows:

To .38 on LL02 set 6 on C scale, at left slide index read .851 on LL02.

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3. Find the per cent reduction in area after a single pass, using Equation 3:

$$R_1 = 1 - C_1 = 1 - 0.851 = 0.149$$

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Answer: The finish reduction in area of 62 per cent can be achieved by six passes of 14.9 per cent reduction in area each (P.D.H.).

Method of Calculating Equal "R's" Followed by a Specified Final "R"

Often in metal working practice a certain hardness of the final product is required. The hardness may be designated by a specified maximum tensile strength, by Brown and Sharp Gauge numbers, or simply by the specified size where the wire should be last annealed and must then be cold drawn to finish size; in other terms, the per cent reduction in area from the last anneal to the finish is specified and must be alloted into the total processing, as shown in the following example:

Example 4: The finish (total) reduction in area is 81.0 per cent to be obtained by 4 equal drawing passes and a specified fifth pass of 22 per cent reduction in area. What is the per cent reduction in area after each of the four equal passes?

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Solution:

1. Find the finish per cent remainder in area and the single per cent remainder in area after the fifth pass, using Equation 4:

$$C_f = 1 - R_f = 1 - 0.81 = 0.19$$

$$C_5 = 1 - R_5 = 1 - 0.22 = 0.78$$

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2. Find the single per cent remainder in area after each of the four equal passes, by using the combined form of Equations 7 and 8 and rearranging terms, as follows:

$$C_f = C_1 \overset{4}{\times} C_5$$

$$C_1 = \sqrt[4]{C_f/C_5} = \sqrt[4]{0.19/0.78} = 0.702$$

3. Find the per cent reduction in area after a single pass of the four equal passes, by using Equation 3:

$$R_1 = 1 - C_1 = 1 - 0.702 = 0.298$$

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Answer: The reduction in area after each of the four equal passes therefore, is 29.8 per cent.

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The problems above dealt with multiple wire drawing, where each die in a series, including the last one in a machine, performs the

same (equal) per cent reduction in area. The same formulas of course hold true if instead of the single dies in a machine, the per cent reduction in area between single annealing steps during the total wire processing is considered.

Method of Calculating Necessary Number of Anneals

If by tensile testing and/or by experience one has found that between anneals a metal or alloy can be drawn a maximum per cent reduction in area without fracture, the minimum number of anneals from base to finish and the annealing sizes of the wire can be determined, as shown in the following example:

Example 5: How many anneals are needed to draw wire from base .250 in. dia., to finish .032 in. dia., if the maximum permissible per cent reduction in area between two anneals is 48 per cent?

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Solution:

1. Find the finish (total) per cent remainder in area, using Equation 5:

$$C_f = (d_f/d_b)^2 = (.032/.250)^2 = 0.0164$$

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2. Find the maximum permissible per cent remainder in area between two anneals, by using Equation 4:

$$C_1 = 1 - R_1 = 1 - 0.48 = 0.52$$

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3. Find the number of anneals for which the per cent remainder in area between two anneals is 52 per cent. This can be done approximately by trial and error; the following method, using Equation 11 is accurate, direct and fast:

$$C_1 = \sqrt[n]{C_f} = 0.52 = \sqrt[n]{0.0164}$$

$$n = 1/\log_{0.0164} 0.52 = 6.29$$

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The number of anneals can be found with the Log Log Duplex Decitrig slide rule, as follows:

Set left index of C opposite 0.0164 on LL03, push hairline to 0.52 on LL02, at hairline read on CI, 629. The number of anneals n = 6.29.

Check the result, by using Equation 8:

$$C_f = C_1^n = 0.0164 = 0.52^{6.29}$$

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The check is made with the slide rule, as follows:

Draw right index of C scale opposite .52 on LL02, push hairline to 629 on C scale, at hairline read on LL03, .0164 = C_f.

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Answer: More than 6, i.e., 7 anneals would be theoretically required. However, in practice fewer anneals may be needed due to the increasing ductility of the wire at small sizes.

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Method of Calculating Annealing and Die Sizes

Knowing the finish (total) per cent reduction in area and the number of anneals or dies between base and finish, one may determine the sequential diameters pertaining to the anneal numbers by equations as derived at in the following: The per cent remainder in area, as expressed in Equation 5, can be applied to single steps from n-1 to n, where n-1 designates a diameter larger than n.

$$C_1 = (d_n/d_{n-1})^2$$

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By rearranging, we arrive to the following Equations:

$$d_n = d_{n-1}\sqrt[2]{C_1} \qquad \text{Eq. 12}$$

$$d_{n-1} = d_n\sqrt[2]{C_1} \qquad \text{Eq. 13}$$

i.e., the smaller diameters are found by multiplying the preceding diameter by the square root of the single per cent remainder in area. Correspondingly, the larger diameters are found by dividing the succeeding diameters by the square root of the single per cent remainder in area. The following Examples 6 and 7 show applications of Equations 12 and 13:

Example 6: In previous Example 5, the number of necessary anneals was found to be 7. What are the annealing sizes, the wire being drawn from base .250 in. dia. to finish .032 in. dia.?

Solution:

1. Find the per cent remainder in area between single anneals, by using Equation 9 and the finish (total) per cent remainder in area, found in Examples 5, 1, above:

$$C_1 = \sqrt[n]{C_f} = \sqrt[7]{0.0164} = 0.556$$

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The result is found by using a Log Log Duplex Decitrig slide rule as follows:

To .0164 on LL03 set 7 on C scale, at right slide index read .556 on LL02.

2. Find the annealing sizes, i.e., the seven diameters d_1 to d_7, where the wire must be annealed, by using either Equation 12 or 13. This may be done by multiplying the base with the factor $\sqrt[2]{C_1}$ six times in a series. The same results are obtained by dividing the finish by $\sqrt[2]{C_1}$ six times in a series.

$$\sqrt[2]{C_1} = \sqrt[2]{0.556} = 0.745$$

The solution is found by adding six times to the log of the base diameter the log 745 = 8725 and finding the antilogarithm to each sum of the logs. The same results are obtained by dividing the finish diameter by $\sqrt[2]{C_1}$ six times in a series. The solution is found by subtracting from the log of the finish six times the log 745 = 8725 and finding the antilogarithm to each difference of the logs, as shown in the following:

	N	L		N	L
$d_0 = .250$		3979	$d_7 = .032$		5051
		+8725			−8725
$d_1 = .186$		2704	$d_6 = .043$		6326
		+8725			−8725
$d_2 = .139$		1429	$d_5 = .058$		7601
		+8725			−8725
$d_3 = .104$		0154	$d_4 = .077$		8876
		+8725			−8725
$d_4 = .077$		8879	$d_3 = .104$		0151
		+8725			−8725
$d_5 = .058$		7604	$d_2 = .139$		1426
		+8725			−8725
$d_6 = .043$		6329	$d_1 = .186$		2701
		+8725			−8725
$d_7 = .032$		505(4)	$d_0 = .250$		397(6)

★ ★ ★

The same results are found faster, by using a slide rule, as follows:

Set slide index to .556 on A scale right, and read the following series:
opposite 32 on D read 43 on C scale,
opposite 43 on D read 58 on C scale,
opposite 58 on D read 77 on C scale,
opposite 77 on DF read 104 on CF scale,
opposite 104 on D read 139 on C scale,
opposite 139 on D read 186 on C scale,
opposite 186 on D read 250 on C scale.

★ ★ ★

Note that opposite 77 on D scale there is no number on C scale. The required larger number was found on CF scale opposite the smaller number on DF scale. By using the DF and CF scales one saves the trouble of moving the slide as well as the attendant scource of error.

★ ★ ★

By starting the series from the finish diameter, the same results are obtained with the same slide position, as follows:

opposite 250 on C scale read 186 on D scale,
opposite 186 on C scale read 139 on D scale, etc.

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Answer: The annealing sizes of the wire are: .186, .139, .104, .077, .058, .043, and .032 in. dia.

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The die sizes for a multiple wire drawing machine are similarly calculated as the annealing steps above, by using the same procedure, as shown in the following example:

Example 7: A multiple wire drawing machine having 6 blocks which are geared to take Brown and Sharp Gauge reducing system steps (20.8 per cent reduction in area per die), is to draw wire to .022 in. dia. The maximum permissible reduction in area is 30 per cent. What are the die sizes and what is the largest possible diameter of the starting wire?

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Solution:

1. Find the single per cent remainder in area of the B & S gauge system, by using Equation 4:

$$C_1 = 1 - R_1 = 1 - 0.208 = 0.792$$

2. Find the die sizes i.e., the five diameters, d_5 to d_1, using Equation 13, by dividing the finish size by $\sqrt[2]{C_1}$ five times in a series.

$$\sqrt[2]{C_1} = \sqrt[2]{0.792} = 0.89$$

The solution is found by subtracting five times the log 89—9494 from the log of the finish diameter and finding the antilogarithm for each difference, as shown in the following:

	N	L
d_6 =	.022	3424
		−9494
d_5 =	.0247	3930
		−9494
d_4 =	.0278	4436
		−9494
d_3 =	.0312	4942
		−9494
d_2 =	.0351	5448
		−9494
d_1 =	.0394	5954

★ ★ ★

The same results are found by using a slide rule as follows:

Set slide index to 792 on A scale right, opposite 22 on D scale read 247 on C scale,
opposite 247 on D scale read 278 on C scale,
opposite 278 on D scale read 312 on C scale, etc.

★ ★ ★

3. Find the single per cent remainder in area for the maximum permissible 30.0 per cent reduction in area that can be effected by the first die, using Equation 4:

$$C_1 = 1 - R_1 = 1 - 0.30 = 0.70$$

★ ★ ★

4. Find the permissible starting size of the wire by dividing the diameter d_2 by the square root of the single per cent remainder in area found (cf. 3.) using Equation 13:

$$d_1 = d_2/\sqrt[2]{C_1} = 0.351/\sqrt[2]{70} = 0.420$$

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The result is found, using the slide rule, as follows:

Set slide index to 70 on A scale right, opposite 351 on D scale read 420 on C scale.

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Answer: The necessary dies are: .0394, .0351, .0312, .0278, .0247, and .0220. The largest starting size permissible of the wire is .0420 in. dia.

V. Length of Wire During Multiple Wire Drawing

During the drawing of the wire, its length and travelling speed becomes succeedingly increased by every die. The ratio of the finish and base lengths of the wire L_f/L_b is proportional to the ratio of the base and finish cross sectional areas of the wire A_b/A_f. The latter is the reciprocal of the per cent remainder in area, or 1/C (cf. Equation 5). This is expressed in the following:

$$L_f/L_b = A_b/A_f = (d_b/d_f)^2 = 1/C \quad \text{Eq. 14}$$

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The finish length may be expressed as a multiple of the base length by setting unity as the base length, as follows:

$$L_f = (d_b/d_f)^2 = 1/C \quad \text{Eq. 15}$$

The following Examples 8 and 9 show applications of the equations above:

Example 8: A wire is drawn from base .190 in. dia. to finish .120 in. dia. What is the finish length of wire expressed as a multiple of the base length?

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Solution: Find the finish length applying Equation 15, by using the slide rule as follows:

To 190 on D scale set 120 on C scale, at the left index of C scale read 250 on A scale.

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Answer: The finish length is 2.5 times the base length, i.e. 250 per cent of the base length or 150 per cent elongation.

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Example 9: A wire is to be drawn 55 per cent reduction in area. a. What is its finish length expressed as a multiple of the base length? b. What is the actual finish length of the wire from 32 feet base length?

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Solution:

1. Find the per cent remainder in area, using Equation 4:

$$C = 1 - R = 1 - 0.55 = 0.45$$

2. Find the finish length of the wire as a multiple of the base length, using Equation 15, as follows:

$$L_f = 1/C = 1/0.45 = 2.22$$

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To find this solution, as well as the following one, the slide rule is set, as follows:

Draw 45 on C scale opposite right index of D scale, at left index of C scale read 222.

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3. Find the actual finish length of the wire, multiplying 222 by 32, without changing the position of the slide, as follows:

Push hairline to 32 on C scale, read 710 on D scale.

★ ★ ★

Answer: a. Finish length is 2.22 times the base length. b. The actual finish length of the wire is 71.0 feet. Note that with the same setting of the slide rule each base length is opposite its finish length.

VI. Speed and Slippage of Wire During Drawing

The travelling speed of wire during drawing is directly proportional to its length, which is taken up by drawing blocks or "take-up drums". If the speed of the wire is faster than the circumferential speed of the rotating drum, the wire slips at the drum. This slippage is undesirable, since it is power consuming and harmful to the surface finish of the wire. The finish drawing, in particular, should have no slippage, i.e. the speed of the wire departing from the finish die should equal the circumferential speed of the take-up drum and must be calculated.

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The circumferential speed of drums having the same axis is directly proportional to their diameter. Therefore, the ratio of the diameters of the first and finish drum D_1/D_f equals the ratio of the starting and finish length L_o/L_f of the non-slipping wire, which is shown, applying Equation 14, in the following:

$$D_1/D_f = L_o/L_f = (d_f/d_o)^2 = C \quad \text{Eq. 16}$$

Notation:

D_1 = diameter of first drum
D_f = diameter of finish drum
L_o = starting length of non slipping wire
L_f = finish length of non slipping wire
d_f = finish diameter of wire
d_o = starting diameter of non slipping wire
C = per cent remainder in area (non slipping)

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A given base wire, having diameter d_b, may be thicker than the calculated diameter d_o for which no slippage was postulated. During the drawing of the wire from d_b to d_o the wire increases its length from L_b to L_o. This extra length, L_b-L_o, cannot be taken up by the drum but will slip. The slippage of wire at a drum is determined by the per cent length of wire which is being furnished and not taken-up by the drum. The length of wire is reciprocal to its cross sectional area. Applying Equations 5 and 3, one obtains for the per cent slippage S the following equation:

$$S = (L_b - L_o)/L_b$$

$$= 1 - L_o/L_b = 1 - A_b/A_o$$

$$= 1 - (d_b/d_o)^2 = 1 - C_o = R_o \quad \text{Eq. 17}$$

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Equation 17 shows that the per cent slippage equals the per cent reduction in area from the given base diameter d_b to the calculated diameter d_o for which no slippage was assumed.

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The following example shows the application of these equations:

Example 9: Wire of .210 in. dia. has to be drawn to .140 in. dia., using two drawing blocks, in shop language called double-decker, with 1st and 2nd block diameters of 17 in. (D_1), and 24 in. diameter (D_2) respectively.

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a. What is the required per cent reduction in area by the finish die if no slippage at the take-up drum (finish) is permissible?

b. What is the diameter d_1 of the first die required for non slippage of the finish wire?

c. Which wire size is drawn thru the first die that does not slip at the first drum?

d. What slippage at the first drum occurs if the given base wire .210 in. dia. is drawn thru the first die?

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Solution a:

1. Find the per cent remainder in area for non slipping wire, applying Equation 16:

$$C = D_1/D_f = 17/24 = 0.71$$

★ ★ ★

2. Find the per cent reduction in area by the finish die, using Equation 3:

$$R = 1 - C = 1 - 0.71 = 0.29$$

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Answer a: The reduction in area by the finish die is 29 per cent.

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Solution b:

3. Find the diameter of the first die, preceding the finish die, by applying Equation 13 and the per cent remainder in area from above:

$$d_1 = d_f/\sqrt[2]{C} = .140/\sqrt[2]{0.71} = .166$$

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The result is found, using the slide rule, as follows:

Set slide index to 71 on A scale right, opposite 140 on D scale read 166 on C scale.

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Answer b: If no slippage is permissible, the first die must be .166 in. dia.

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Solution c:

4. Find the diameter d_o of a wire drawn thru the first die that does not slip at the first drum, applying Equation 13:

$$d_o = d_1/\sqrt[2]{C} = .166/\sqrt[2]{0.71} = .197$$

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The result is found, using the same slide rule position as in Solution b, 3.:

(*Please turn to page* 1507)

The Performance of Vinyl Insulation Rated for 75°C THW Service

by H. L. Wuerth
Manager, Wire and Cable Materials
Plastic Materials Sales
B. F. Goodrich Chemical Company
Cleveland, Ohio.

Your Program Committee requested that I talk about 75° C THW rated wire. In fact, they suggested that it would be of interest to this conference to discuss the historical background of THW. Since 75° C THW has not yet been established in the National Electric Code, a literal interpretation of this request for historic information created some consternation for the author. Other complications existed so this assignment was accepted with some trepidation. The paper had to be prepared in advance of certain technical committee recommendations which could alter the relative importance of the facts to be presented. There has existed also the remote possibility that continued industry committee deliberations might forestall recognition of a THW rating for a prolonged period, thus reducing the current interest in this topic.

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In spite of this apparent confusion there exists a good 20 year history of the performance of vinyl insulation and from this we may derive some significant factors for the design of a good vinyl insulation for 75° C THW service.

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PVC insulated wire was introduced in 1937 and Underwriters' listings were established by 1939. The 1940 National Electric Code first recognized Type SN wire for open wiring and for use in existing raceways. Thereafter rapid strides in the chemistry of vinyl compounding and the development of improved processing techniques led to the establishment of 60° C TW ratings and 80° C appliance ratings during the period from 1943 to 1945. Complete recognition of T and TW by the code in 1946 finally established vinyl insulation in the building wire field. By 1949 PVC insulation obtained Underwriters' listing for 105° appliance wiring.

H. L. Wuerth

Mr. Wuerth received his Bachelor of Chemistry and Chemical Engineering degree from Cornell University in 1937. He joined Anaconda Wire and Cable Company after graduation and in 1946 became a technical service engineer on wire and cable materials for the B. F. Goodrich Chemical Co. He was transferred to the New York sales office in 1947 and in 1955 was appointed to his present post.

This paper was presented by the author at the Annual Convention of The Wire Association at Atlantic City, N. J., on October 15, 1958.

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In 1948 a dual service rating for vinyl insulation was established that provided performance history worthy of note. This was an 80° C appliance wire rating suitable for 60° C TW service. This dual rating was later established at an even higher level by combining a 105° C rating with 60° C TW.

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The adoption of these more heat stable compounds offered the industry higher quality insulation although limited by the code to a maximum operating temperature of 60° C where used in wet locations.

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Under special conditions not under code jurisdiction, many millions of feet of vinyl insulated wire of this type have been installed in wet locations for circuits designed with current carrying capacities based on 75° C ratings.

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Based on the foregoing experience, it became logical for the industry to request a complete 80° C rating for use in wet locations. We accepted this assignment about the time RHW was being established for 75° C so our objective became the 75° C THW rating.

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More specifically, our objectives were—

An improved, extremely versatile, all-purpose building wire.

Recognized suitability for operation in wet locations at temperatures up to 75° C.

Accommodation for more conductors in the rewiring of existing conduits.

Substantial increases in conductor current carrying capacities (where voltage drop is not the ruling factor).

Offer at least a ten per cent greater over-all economy by making possible designs for operation at 75° C. compared to 60° C.

Additional safety factor for conditions producing elevated temperatures.

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The major performance characteristics considered necessary to secure these objectives were:—

High resistance to, or adequate physical and chemical stability for extremes of heat and moisture.

Ability to withstand the physical abuse involved during installation.

Sufficient resistance to high temperature flow to prevent serious damage under maximum operating conditions.

Stable electrical properties for consistent performance and long life under service conditions.

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Our early appraisal of the project indicated that the insulation must show performance at 75° C comparable to that of Type TW insulation at its rated temperature of 60° C.

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In order to design an acceptable compound, we had to know what test requirements the industry would demand. Thereupon, it became necessary to arrange a fact-finding investigation with an authoritative laboratory to determine what test requirements should be established and what performance characteristics would be necessary.

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Under these conditions a fact-finding investigation was arranged at an early stage with the Underwriters' Laboratories. The results of this study were submitted to technical advisory committees in the wire and cable industry and to the responsible code panel in 1955 for recognition of a 75° C THW rating in the 1956 National Electrical Code.

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It was the considered judgment of the authorities that the compound submitted did not provide a high enough level of performance to permit a 75° C THW rating.

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In brief, the jump to 75° C for thermoplastic building wire introduced engineering considerations demanding a much higher level of performance than the level accepted for 60° C TW.

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The first investigation provided valuable experience for determining the necessary qualifications and we were in a position to proceed with a new compound which would meet higher performance standards. The criticisms of the first submittal indicated to us three principal areas where improved properties were most essential for the high quality performance demanded:

1. **Improved heat resistance or heat stability to prevent physical or chemical deterioration under the most extreme conditions which could be encountered on 75° C. rated circuits.**
2. **Improved resistance to high temperature flow.**
3. **Improved electrical stability at rated temperatures in the presence of moisture.**

★ ★ ★

The course of our development work during this period offered a solution to all of these problems. An excellent performance record had been established for a semi-rigid high temperature compound Geon 8800. It was qualified in the following recognized industry categories:

Underwriters' Laboratory Listings:
60° C TW BUILDING WIRE
80° C - 90° C - 105° C APPLIANCE WIRING MATERIAL
80° C IN OIL

Military Aircraft Wiring Specifications:
MIL-W-5086
NAS-702 (CLASS A and B)

Military Hook-Up Wire Specifications
MIL-W-76A
MIL-W-16878B

★ ★ ★

An Underwriters' Laboratories fact-finding investigation undertaken with this new compound established its superior performance in the areas of heat, mechanical and electrical stability. A summary of these data is given in the appendix of this paper. No attempt will be made here to comment in detail on all of these tests. There are a few, however, which offer some interesting comparisons and highlight the quality performance deemed necessary for dependable 75° C THW service.

Heat Resistance— U/L Accelerated Aging

Data from U/L fact-finding investigation of Geon 8800 for Type THW.

1A. Accelerated Aging
Percentage of Original Elongation:

After 60 Days at 82°C	99
After 7 Days at 100°C	100
After 10 Days at 100°C	100
After 7 Days at 121°C	99
After 10 Days at 121°C	98

1B. (1/64 Inch Wall on #20 AWG Stranded (7/28)

Physical Properties:	
Original Tensile Strength (PSI)	3940
Original Elongation (%)	293
Retention of Elongation (%)	
4 Days at 136°C	98.5
4 Days at 150°C	90
60 Days at 113°C	100
240 Days at 113°C	70

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This test was performed also on #6 AWG with ten pound weights and #4/0 AWG with 50 pound weights.

AFTER 20 DAYS AT 75 C

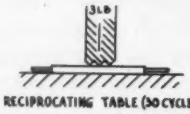
# 6 AWG	82 Per cent deformation
#40 AWG	82 Per cent deformation

Dielectric Strength After Flow Test-U/L

Identification of Samples and Aging	Average Breakdown (Two Coils) Kilovolts
After Aging in air for 20 days at 75 C	
Black THW (Geon 8800)	25.0
Natural THW (Geon 8800)	25.0
Comparison RH-RW Mfgr. A	23.2
Comparison RHW Mfgr. C	25.0
Comparison RH Mfgr. D	19.8
Comparison RH Mfgr. F	22.8
After Aging in air for 20 days at 60 C	
Comparison TW Mfgr. B	20.5
Comparison TW Mfgr. E	23.8
Comparison TW Mfgr. G	15.3

SKETCH 2

U/L ABRASION AT ROOM TEMPERATURE



RECIPROCATING TABLE (30 CYCLE/MIN.)

IDENTIFICATION OF SAMPLES	AVERAGE (3 SAMPLES) NUMBER OF CYCLES TO EXPOSE CONDUCTOR
BLACK THW	2769
NATURAL THW	2012
COMPARISON RH-RW MANUFACTURER A	262
COMPARISON RHW MANUFACTURER C	1303
COMPARISON RH MANUFACTURER D	272
COMPARISON RH MANUFACTURER F	1267
COMPARISON TW MANUFACTURER B	95
COMPARISON TW MANUFACTURER E	190
COMPARISON TW MANUFACTURER G	202

NOTE TYPES RH, RH-RW, AND RHW SAMPLES TESTED WITH PROTECTIVE COVERINGS IN PLACE ON ALL TESTS.

The Underwriters' requirements —samples must withstand 2000 volts potential for one minute without breakdown. #6 AWG withstood 25,000 volts for one minute. #4/0 withstood 25,000 volts after ten days at 75° C on the flow test and 6,000 volts after twenty days.

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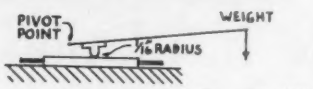
Another interesting and most significant test was conducted to

SKETCH 3

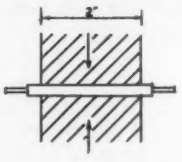
SLOW COMPRESSION AT ROOM TEMPERATURE U/L



SAMPLE DESCRIPTION	AVERAGE GROUNDING FORCE (AVERAGE OF 10 TRIALS) POUNDS
COPPER AT ROOM TEMPERATURE	
BLACK THW	106.9
NATURAL THW	126.9
COMPARISON RH-RW MANUFACTURER A	80.5
COMPARISON RHW MANUFACTURER C	109.6
COMPARISON RH MANUFACTURER D	125.7
COMPARISON RH MANUFACTURER F	143.5
COMPARISON TW MANUFACTURER B	42.8
COMPARISON TW MANUFACTURER E	78.8
COMPARISON TW MANUFACTURER G	57.9

SKETCH 4

CRUSHING TEST U/L AT ROOM TEMPERATURE

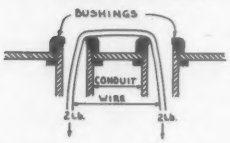


SAMPLE DESCRIPTION	AVERAGE GROUNDING FORCE (AVERAGE OF 10 TRIALS) POUNDS
BLACK THW	2000
NATURAL THW	2120
COMPARISON RH-RW MANUFACTURER A	1735
COMPARISON RHW MANUFACTURER C	2180
COMPARISON RH MANUFACTURER D	1440
COMPARISON RH MANUFACTURER F	1460
COMPARISON TW MANUFACTURER B	830
COMPARISON TW MANUFACTURER E	1325
COMPARISON TW MANUFACTURER G	870

simulate extreme field conditions. Nine #14 AWG conductors with 1/32 inch wall of insulation were pulled through a section of ½ inch conduit which had been bent 180° at a minimum radius of 4 inches. The "U"-shaped assembly was inverted and 18 pounds stress applied to the ends of the conductors to simulate the weight of a vertical 100 foot length of wire. After this assembly was exposed to 100°C (25° C above the 75° C rated temperature) for a period of 6 weeks, the minimum dielectric strength from conductors to the conduit was 18,000 volts. The insulated conductors were not bonded to each other or to the conduit.

SKETCH 5

RESISTANCE TO FLOW - U/L



IDENTIFICATION OF SAMPLES AND AGING	DETERMINATION (AVERAGE OF TWO CALCULATIONS), PER CENT
AFTER AGING IN AIR FOR 20 DAYS AT 75 C	
BLACK THW	63.8
NATURAL THW	64.2
COMPARISON RH-RW MANUFACTURER A	31.9
COMPARISON RHW MANUFACTURER C	36.2
COMPARISON RH MANUFACTURER D	46.3
COMPARISON RH MANUFACTURER F	32.8
AFTER AGING IN AIR FOR 20 DAYS AT 60 C	
COMPARISON TW MANUFACTURER B	73.2
COMPARISON TW MANUFACTURER E	65.6
COMPARISON TW MANUFACTURER G	71.4

Electrical Stability

Electrical stability at rated temperatures was determined by standard Underwriters' procedures for insulation resistance and SIC determination. In addition, further measure of stability was obtained by the newer dielectric decline test.

Specific Inductive Capacitance

The values listed are the average of two samples each of black, natural, red, and green.

Specific Inductive Capacitance	
At 30° C and 1000 CPS:	
After 1 day	5.42
Per cent change, 1st to 14th day	3.95
Per cent change, 7th to 14th day	1.17
At 75° C and 1000 CPS:	
After 1 day	8.15
Per cent change, 1st to 14th day	1.34
Per cent change, 7th to 14th day	0.61
Per cent change, 14th to 28th day	0.55

Dielectric Decline

Samples as received withstood 25,000 volts (limit of the testing transformer).

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Per cent decline in dielectric strength after 14 days immersion in water:

At 70° C	0
At 85° C	5

Insulation Resistance

A summary of data from the original Underwriters' fact-finding investigation is listed in the appendix.

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Graph I represents 100 weeks immersion at 75° C in our laboratory.

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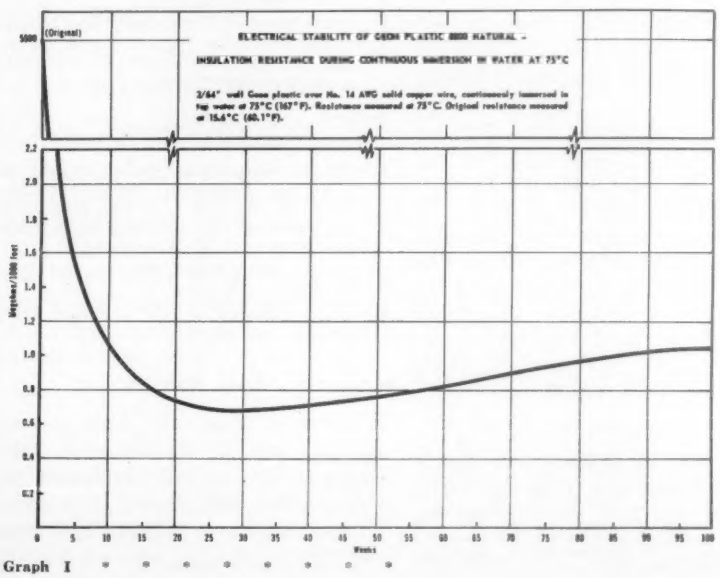
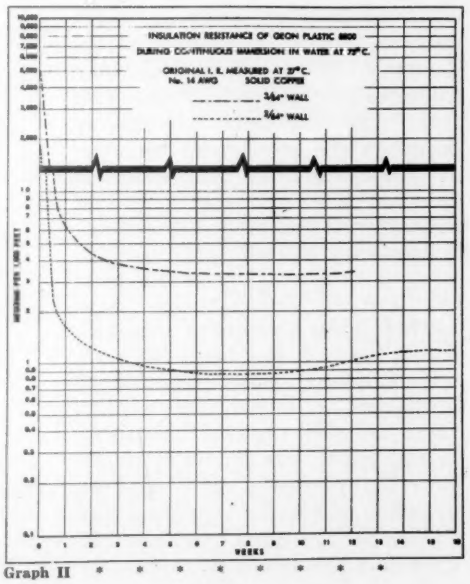
Graph II is a semi-log plot of

(*Please turn to page* 1526)


ELECTRICAL STABILITY OF GEON PLASTIC 8800 NATURAL -
INSULATION RESISTANCE DURING CONTINUOUS IMMERSION IN WATER AT 75°C
(Original)
Megohms/1000 feet
Weeks

Graph I


INSULATION RESISTANCE OF GEON PLASTIC 8800
DURING CONTINUOUS IMMERSION IN WATER AT 75°C.
ORIGINAL I. R. MEASURED AT 25°C.
No. 14 AWG SOLID COPPER
1/32" WALL
3/64" WALL
MEGOHMS PER 1,000 FEET
WEEKS

Graph II

Tests to Evaluate the Lightning Behavior of Telephone Wire and Cable Insulation

by D. W. Bodle

Bell Telephone Laboratories, Inc.

Murray Hill, New Jersey

This paper was presented at the Annual Convention of The Wire Association in Atlantic City on October 15, 1958.

Introduction

The "guaranteed" dielectric strengths of telephone wire and cable conductors are necessarily lower than the actual voltage withstand ability of the greater part of the product concerned. Dielectric tests conducted during various stages of manufacture are intended primarily to detect serious defects and do not provide a satisfactory basis for predicting field performance and establishing electrical protection requirements.

★ ★ ★

The d-c and 60 cycle a-c peak voltage breakdown values of paper-insulated conductors are approximately the same and on surge potentials, breakdown occurs at only a slightly higher value which is characteristic of gap sparkover in air. Since the dielectric strength of plastic insulations far exceeds that of air, dielectric breakdown behavior becomes more nearly a function of the materials themselves with the result that considerable differences exist in their relative breakdown values on a-c, d-c and surge potentials. This radical departure of plastic insulations from the common conceptions based on the breakdown behavior of paper-insulated conductors is frequently not recognized and available information on this point is relatively limited.

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There have been some data published [1][2] on the breakdown relationships of solid polyethylene insulation on larger size conductors; however, the study discussed in this paper was conducted to secure information on the breakdown behavior of plastic insulation specifically of the types and sizes now used in the manufacture of telephone cable and outside wire plant, especially with regard to their surge breakdown characteristics. Rubber and paper insulations, for which there is a significant amount of field operating data, were included to provide a basis for predicting the field behavior of the plastic insulations. This paper presents the results of these tests and discusses the relationships established.

Testing Procedure

Thirty specimens having an eight-foot active length were employed in each test. This sampling appears to be adequate as the results reasonably approximate a normal distribution. All of the solid plastic insulated and rubber covered specimens were tested in water. The two ends of the conductor under test were connected together and energized with respect to the water. Specimens having insulation such as paper, and expanded polyethylene were tested in a bed of small diameter (.050") metallic pellets. The temperature of the water and metallic pellets used in these tests was approximately that of the ambient air (72°F). In the steady state tests (a-c and d-c), starting at zero, the potential was increased at the rate of 500 volts per second until breakdown occurred. Surge tests were made with a nominal 1½ x 40 microsecond wave*, the crest value of which was increased in steps until breakdown occurred.

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Early in the program a significant difference was noted between the breakdown values observed with the 1½ x 40 micro-second surge and with gradually increasing d-c potential. A special test was made to sample this effect with a 60 x 125 micro-second surge using .005" solid polyethylene on 26 ga. conductors.

★ ★ ★

The plastic-insulated specimens were given a 500 volt megger test prior to the program tests to insure that they were free from obvious defects.

★ ★ ★

Insulation thicknesses were standard for the conductor sizes involved. Following is a description of the various specimens tested:

1. Polyvinylchloride—.010" covering on a 24 ga. conductor.
2. Solid Polyethylene—(High Molecular Weight, Melt Index: Max. 0.40 Min. 0.20 Grams/10 minutes).
   a. .005" covering on a 26 ga. conductor.
   b. .012" covering on a 19 ga. conductor.
3. Experimental Expanded Polyethylene (Low Molecular Weight, Melt Index: Max. 2.1 Min. 0.8 Grams/10 minutes)
   a. 35%*—.017" covering on a 19 ga. conductor.
   b. 49%*—.0155" covering on a 19 ga. conductor.
4. Paper—Strip Type (⅛" x .0035") on a 19 ga. conductor. Because of the twist of the paper on the conductor, the nominal effective thickness could not be definitely determined.
5. Paper—Pulp type: .0075" covering on a 26 ga. conductor.
6. GR-S (Rubber)—.021" covering on a 22 ga. conductor.

Test Results:

The test data were first plotted in the form of cumulative graphs which indicated that the statistical distribution was reasonably good. Curves shown in figures 1, 2 and

* 1½ micro-second rise time to crest value and 40 micro-seconds to point where the wave has decayed to ½ of its crest value. Reference point in both cases is t=o.

* Per cent of gas by volume.

3 for the case of .012" solid polyethylene on 19 ga. copper conductors are representative of the type of distributions also obtained with the other test specimens. Median breakdown values secured from such curves are the basis for the comparisons presented in Table 1.

FIG. 1

60 CYCLE BREAKDOWN OF SOLID POLYETHYLENE INSULATION
(.012 INCH COVERING ON A 19GA CONDUCTOR)
8 FOOT SINGLE CONDUCTOR SPECIMENS TESTED IN WATER

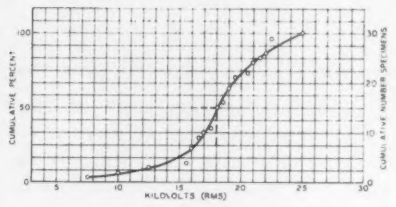


FIG. 2

SURGE BREAKDOWN OF SOLID POLYETHYLENE INSULATION
(.012 INCH COVERING ON A 19GA CONDUCTOR)
8 FOOT SINGLE CONDUCTOR SPECIMENS TESTED IN WATER
1-1/2 x 40 USEC SURGE

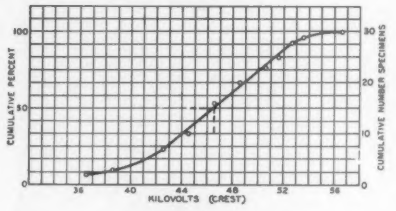
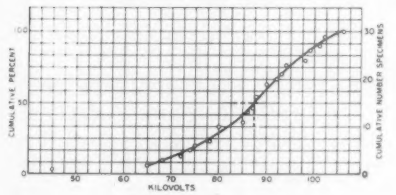


FIG. 3

DC BREAKDOWN OF SOLID POLYETHYLENE INSULATION
(.012 INCH COVERING ON A 19GA CONDUCTOR)
8 FOOT SINGLE CONDUCTOR SPECIMENS TESTED IN WATER



Published data[3] on the effect of temperature variations on the d-c dielectric strength of solid polyethylene indicates approximately a 26% decrease at 140°F (60° C) as compared with its strength at 72°F (22°C). The decrease in dielectric strength for the same temperature range on 50-60 cycles a-c is approximately 30% in peak voltage value.

★ ★ ★

In relating the results of these tests which were secured at approximately 72°F (22°C) to situations where the insulation temperature may be substantially higher, some derating of the breakdown strengths of polyethylene given in Table 1 may be in order.

TABLE 1

Breakdown Relationships

Type	Insulation Thickness	Conductor Guage (AWG)	Median Breakdown (Kilovolts) 60 (rms)	D.C.	Surge 1-1/2x40	Surge 60x125	Breakdown Ratios With Respect to 60 cycle rms Volts D.C.	Surge 1-1/2x40	Surge 60x125
Polyvinylchlorides	.010"	24	15.2	41.0	39.5	---	2.7	2.6	---
Solid Polyethylene	.005"	26	6.05	25.0	11.6	16.5	4.1	1.9	2.7
Solid Polyethylene	.012"	19	18.0	87.5	46.5	---	4.9	2.6	---
35% Expanded Polyethylene	.017"	19	4.7	9.7	9.3	---	2.05	1.98	---
49% Expanded Polyethylene	.0155"	19	2.25	3.88	3.68	---	1.72	1.63	---
Paper Strip	*	19	1.14	1.66	1.97	---	1.45	1.73	---
Paper-Pulp	.0075"	26	.76	1.10	1.27	---	1.45	1.67	---
GR-S (Rubber)	.021"	22	17.1	36.0	34.1	---	2.1	2.0	---

*No consistent determination of thickness because paper tapes are applied in a wrinkled configuration.

Discussion:

The results secured with the paper-insulated specimens show that breakdown occurs at practically the same 60 cycle peak value that it does on d-c potential and at about 20% higher value on surge crest potential. This closely approximates the breakdown behavior of air between bare electrodes and confirms the assumption that paper insulation of the type used in telephone cable contributes little as a dielectric material but primarily provides mechanical separation.

★ ★ ★

Marked departures from the breakdown relationships observed with paper insulation were noted with the other materials tested. The difference between d-c and 60 cycle (rms) breakdown was considerably greater, especially in the case of solid polyethylene where d-c breakdown occurred at values 4 to 5 times higher than on 60 cycles (rms). Surge behavior also differed significantly from that of paper in that breakdown occurred at lower values than on d-c. Again solid polyethylene showed the greatest departure in this respect of the materials tested, breaking down on 1½ x 40 surges at peak voltages about one half that of their corresponding d-c breakdown values.

Application of Test Data

It is recognized that the absolute breakdown values secured in these tests on short specimens of new conductor cannot be employed directly in field problems, since they do not include some probable reduction in insulation strength due to subsequent factory operations and field handling. Nevertheless, the breakdown relationships shown in Table 1 can be of considerable practical use.

★ ★ ★

The relationships between a-c and d-c breakdown could be used in comparing production test results on a given type of insulated wire manufactured at different locations where a-c and d-c testing has been employed depending on the availability of facilities. However, the principal usefulness of these data are in the solution of electrical protection problems.

★ ★ ★

Improved construction has minimized the number of power contacts and good coordination practices have reduced the resultant damage. Lightning remains the principal source of foreign potentials that damage communication plant.

★ ★ ★

Dielectric strength is an important factor in evaluating the protection requirements for a given

(*Please turn to page* 1529)

Experimental Prestressed Concrete Highway—An Engineering Report

by Carlton W. Garrett
Metallurgical Engineer
Product and Development Division
Jones & Laughlin Steel Corporation
Pittsburgh, Pennsylvania

This presentation was made at the Annual Convention of The Wire Association in Atlantic City, N. J., on October 15, 1958.

The major consideration in it was the showing of a film which depicted the making of reinforcing fabrics, the methods of installation in the experimental highway and the manner of testing.

It was preceded by introductory remarks by Mr. Garrett and followed by comments on what had been shown.

These comments are published here.

We wish to thank The Wire Association for the privilege of presenting this film depicting the step-by-step construction and the testing of our experimental prestressed concrete highway.

★ ★ ★

One important result of the accelerated highway program is that research in construction methods, highway design, soil mechanics and even highway usage has been greatly stimulated by the magnitude of the program.

★ ★ ★

Modern highways carry heavy loads, at high frequency rates and at high speeds. Ultimate in design of sub-grade, pavement profile, traffic control, etc., and especially of the pavement itself, is essential. The pavement surface should be safe, smooth and durable. It should prevent infiltration of water into the sub-grade. Pavement maintenance must be kept to a minimum, not only for economy, but also to maintain the utility and safety of the highway and to minimize traffic obstruction during repair.

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Development of such a pavement was the objective of the experiment in prestressed concrete highway construction by our company.

★ ★ ★

The scope of this project was sufficiently extensive, not only to provide valuable design data, but also to demonstrate the practicability of the method, and to establish its economy compared with conventional concrete pavements.

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The experiment was made full scale in order to provide as much construction information as possible, as well as to provide the contractor who built the pavement with sufficient data to project the construction costs to actual highway operations. To accomplish this, the experimental slab was made a full 12-foot lane width with a total length of 530 feet. The motion picture you are about to see makes unnecessary any detailed description of the construction of the project. Some of the basic findings are noted in the picture, but we would like to make a few additional remarks at the conclusion of film.

Showing of the Film

We hope that you have enjoyed the film. Our remarks will be limited as much as possible to avoid unduly prolonging the session.

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Of particular interest to this audience, we believe, would be the data on the prestressing tendons. As noted in the film, each of the six tendons consisted of four prestressing strands enclosed in a flexible steel duct. The seven wire, 7/16" strands were processed from lead quenched, hard drawn C-1080 steel wire, stress-relieved, after stranding, to result in a mimimum tensile strength of 250,000 psi. (Actually, two reels were made for this project and were checked at 263,-500 psi. with a 9.5% elongation and 273,500 psi., 10.5% elongation). When the strands were strained 24 inches in the 400-foot length the unit stress varied from an average of 152,000 psi. at the jacking point to 118,000 psi. at the ends of the section, the average being 135,000 psi.

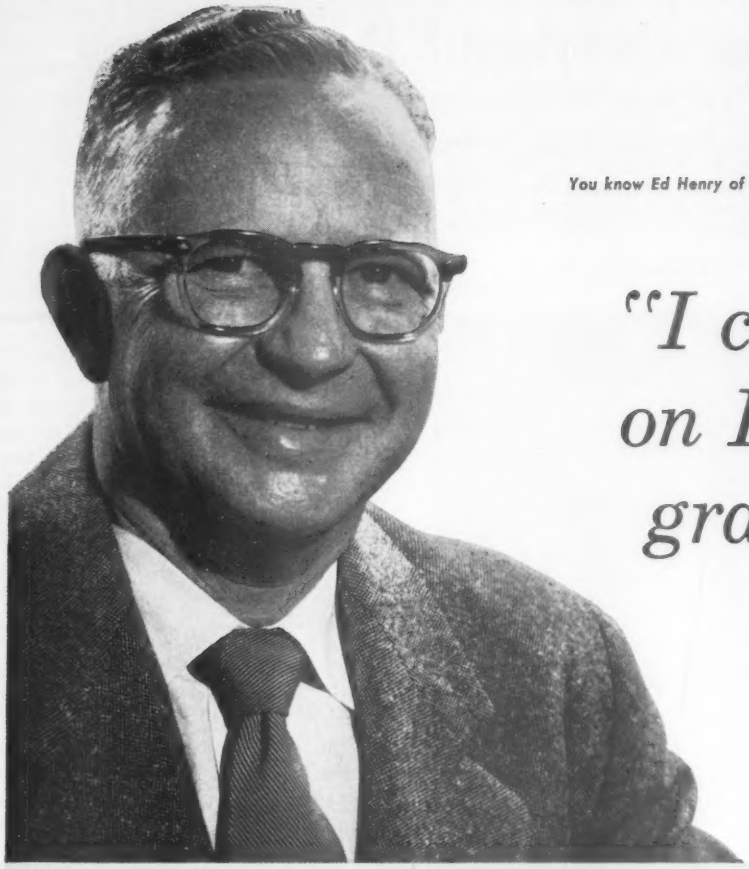
★ ★ ★

The prestressed concrete market currently consumes approximately 25,000 tons of steel per year. The aforementioned accelerated highway program envisions approximately 130,000 lane miles of highways for the interstate portion and a like amount for urban and secondary roads spread over a thirteen-year period. Consider a conservative 10% of the proposed roadways to be of prestressed concrete construction and a potential market of 500,000 tons of high tensile steel wire or cable would be added to the present requirements. This should be of great interest to you as representatives of the wire industry.

★ ★ ★

Jones & Laughlin has done and is continuing to do considerable

(*Please turn to page* 1524)



You know Ed Henry of Hedalloy Die Corporation. He says . . .

"I can rely on ELGIN grading"

. . . and precision grading is a must for highly finished work surfaces where scratches cannot be tolerated.

The inset illustration shows the world's largest boltmaker die, made by Hedalloy Die Corporation—one foot long and nearly seven inches in diameter! Because a single scratch during finishing would mean a loss of countless hours of work, Hedalloy specified Elgin Precision Graded DYMO-C* . . . to be sure.

*C for carbide

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Fabrication and Properties of 5005 Aluminum Alloy Cables for Overhead Power Lines

by Harold W. Adams
Director, Electrical Conductor Products
Industrial Products Department
Reynolds Metals Company
Richmond, Virginia

Background

For the electric power industry there has existed a need for a homogeneous aluminum alloy cable having more strength, and therefore better sag characteristics, than one made of EC grade aluminum. Ideally, such a strong alloy cable should have manufacturing processes such that its cost would be low and it could be produced on equipment already available in all wire and cable manufacturers' plants. With 5005 aluminum alloy, Reynolds has developed cables which meet these requirements.

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While details of application problems are not within the scope of this discussion, and understanding of some of the factors relating to application is necessary in order to appreciate the reasoning behind the development of 5005 cables. Of these factors the interrelationship between tensile strength and sag characteristics is perhaps the single factor of greatest interest. This is true because 5005 alloy cables must be considered as alternates to cables made of even stronger alloys which have been in use in Europe for many years and which are now available in this country. While 5005 alloy cables provide tensile strength about midway between electrically equivalent EC and 6/1 ACSR cables, the stronger alloys provide strength of the same order as the ACSR. To develop this greater strength, however, heat-treatable alloys are used and production sequences involve cold drawing, heat treating, aging and a second cold drawing to the finished diameter. These manufacturing processes are costly compared to the single cold drawing step required for a non-heat-treated wire such as 5005 and they limit participation to those manufacturers who may see fit to equip themselves for processing heat-treated wires on a volume basis.

Harold W. Adams

The author was graduated from Georgia Tech in 1939 with a degree of B.S. in Electrical Engineering. He served for several years as an officer in the U. S. Army Signal Corps and spent a number of years in the design of utility transmission lines and systems prior to joining Reynolds in 1949 as Chief of the Engineering Section of the Cable Division. He is a Registered Professional Engineer and a member of AIEE, ASTM, ASM, IPCEA and The Wire Association.

He presented this paper at the Annual Convention of The Wire Association in Atlantic City, N. J., on October 15, 1958.

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Perhaps the most important fact to bear in mind is that even though a cable made entirely of a strong aluminum alloy may have about the same breaking strength as an ACSR cable, this does not mean that it will have the same sag and tension relationships in an overhead span. In actual practice the relationships of sags and tensions must be considered throughout a broad temperature spectrum and under various conditions of mechanical loading with ice and wind. In addition to strength, therefore, sag and tension relationships are influenced by other properties of the cables such as initial modulus of elasticity, final modulus of elasticity, temperature coefficient of expansion, fatigue endurance limit, creep, weight and physical size. In addition, sags and tensions are influenced by line design parameters such as weather conditions to be designed for, strength of supporting structures, normal span lengths, etc.

★ ★ ★

A second important fact to remember is that in relatively short span construction, there almost always exist circumstances where a very small change in sag can result in a very large change in tension. In such circumstances it is possible to hold tensions to values within the permissible limits of a 5005 conductor by providing an inconsequential increase in sag. This is the basic reason why the application of 5005 conductors is expected primarily to be in the area of urban subtransmission and distribution. In the final analysis, of course, the conductor selected will be the one which meets all service requirements at the lowest overall cost of construction and operation.

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With the above factors in mind, three basic requirements were

initially established for a strong aluminum alloy which might be considered for wires and cables for overhead conductors. These requirements were as follows:

1. **It must be non-heat-treated so that wires may be produced in the same manner and on the same equipment as EC.**
2. **It must have substantially more tensile strength than EC grade aluminum. No specific value was fixed as to what this strength should be, however.**
3. **It must have conductivity such that a 7-strand cable made of it would have the same conductance as conventional 6/1 ACSR of the same physical size. This is important so that available accessories and connectors designed to fit ACSR will fit the electrically equivalent strong alloy cable also.**

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All of the above requirements are completely realized with 5005 alloy. Of all construction for which strong aluminum alloy cables are suitable, it is believed that 5005 meets the technical requirements for the vast majority of them.

Fabrication of 5005 Cables

In the manufacture of 5005 redraw rod Reynolds uses the same unique process used for EC. Large ingots are rolled into sheet, the sheet is slit into rectangular strips, and the strips are cold rolled into ⅜" round rod. Coils of the rod are then processed through a conveyorized stress-relieving furnace to produce the desired temper for wire drawing. Specified properties of the various tempers of ⅜" 5005 redraw rod are as shown in Table 1.

TABLE 1

Temper	Ultimate Strength (psi)	Minimum Conductivity (% IACS)
5005-H16	24,000 - 32,000	52.6
5005-H14	22,000 - 28,000	52.7
5005-H12	20,000 - 25,000	52.8
5005-O	16,000 - 22,000	53.1

Wire drawing of 5005 is accomplished on the same machines, using the same dies, lubricants and drawing speeds as for EC. The tempers of rod found to be most suitable in our plant for various finished wire diameters are as shown in Table 2.

TABLE 2

Temper	Finished Wire Diameter (inches)
5005-H16	0.1200 and larger
5005-H14	0.1200 to 0.2100
5005-H12	0.0700 to 0.1199
5005-O	0.0500 to 0.0699

Stranding of 7-strand cables is accomplished on the same tubular stranders that are used for stranding ACSR or EC cables. The wire, being somewhat stiffer, is a little more difficult to lay smoothly through the closure dies, and initially it was found desirable to pass the cable through post-forming rolls mounted directly behind the closure die. With experience it was found that with closer attention to the closure die, and with effective control of spool brake tensions, the post-forming operation could be eliminated. Stranding of multi-layer cables is accomplished on rigid head stranders without any basic changes in techniques used for stranding EC.

★ ★ ★

Wire drawing practices are the same as those used for EC. The only variation is that reductions must be controlled somewhat more closely to the nominal design reductions than required for EC.

★ ★ ★

Covering of 5005 wires and cables with neoprene or polyethylene is accomplished with the same techniques as with EC. Because the 5005 is stronger, there is less possibility of breaking during the covering process. No changes in the properties of the conductor have been observed after covering with either neoprene or polyethylene.

When 5005 cables are used as the bare neutral messenger, multiplexing is accomplished with a somewhat better tightness of wrap, especially in the smaller sizes, than when the neutral is all EC. This is because of the increased stiffness.

★ ★ ★

An advantage to the plant in processing 5005 cables rather than ACSR is that plant generated scrap can be disposed of with much greater ease. This, of course, is because of the absence of the steel core wire.

Properties of 5005 Wires

The properties of 5005 which relate to applications factors are of primary interest, and their significance can be best appreciated if they are compared with the same properties of a familiar material. In the following discussion, therefore, comparison in each case is made with EC, the performance of which is well known.

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1. Composition:
   The nominal composition of 5005 alloy is .8% magnesium with the remainder being aluminum and impurities. EC has no alloying constituent and has .55% maximum impurities.
2. Tensile Strength and Elongation:
   The guaranteed tensile and elongation properties of 5005 alloy wires are as shown in Table 2a, along with those of EC for ready comparison.
3. Conductivity:
   The guaranteed minimum conductivity of hard drawn 5005 alloy wires is 52.14% of the International Annealed Copper Standard (I.A.C.S.), compared to 61% for conventional hard drawn EC wires.
4. Modulus of Elasticity:
   The nominal modulus of elasticity of 5005 hard drawn wire is 10×10^6 psi, the same as for EC. This is somewhat misleading, however, because the modulus of stranded cables is inherently different from that

TABLE 2a

Diameter of Wire (Inches)	Tensile Strength (psi)				Minimum Elongation in 10 In. (%)	
	Minimum		Average for lot			
	5005	EC	5005	EC	5005	EC
.0701 - .0800	36,500	26,500	37,500	28,000	1.4	1.4
.0801 - .0900	36,000	26,000	37,000	27,500	1.5	1.5
.0901 - .1000	35,500	25,500	36,500	27,000	1.5	1.5
.1001 - .1100	35,000	24,500	36,000	26,000	1.5	1.5
.1101 - .1200	34,500	24,000	35,500	25,500	1.6	1.6
.1201 - .1400	34,500	23,500	35,500	25,000	1.7	1.7
.1401 - .1500	33,500	23,500	34,500	24,500	1.8	1.8
.1501 - .1600	33,000	23,000	34,000	24,000	1.9	1.9
.1601 - .2100	31,000	23,000	32,000	24,000	2.0	2.0

of solid wires as a result of the helical stranding. This is discussed in more detail in the section dealing with stress-strain characteristics of 5005 cables.

5. Coefficient of Thermal Expansion:

   The average coefficient of thermal expansion of 5005 alloy at normal temperatures is 12.8 x 10^{-6} per degree Fahrenheit, the same as that for EC.

6. Temperature Coefficient of Resistance:

   The temperature coefficient of resistance of 5005 alloy wire is .00344 at 20° Centigrade per degree Centigrade, compared with .00403 for EC.

7. Specific Gravity:

   The specific gravity of 5005 alloy is 2.70, the same as that of EC.

8. Hardness:

   The Rockwell 15T hardness number (15 Kg load, 1/16" ball) for 5005 hard drawn wire is about 71. The number for hard drawn EC wire is about 55.

9. Fatigue:

   The fatigue endurance limit of hard drawn EC aluminum is usually taken to be 7000 psi. Actually, however, this value is difficult to establish and is strongly influenced by methods of test, preparation of samples, etc. To permit a direct comparison of the fatigue characteristics of EC and 5005 wires, Reynolds arranged for a series of tests in two different and independent laboratories. For the tests, samples of .133" diameter hard drawn wires of each alloy were obtained from commercial production from the same wire drawing machine. Rotating—buckling type tests were employed in both laboratories, and data showed very consistent and reproducible trends. Results were as shown in Table 3.

TABLE 3

Testing Laboratory	Alloy Wire	Tensile Strength (psi)	Fatigue Limit (psi)	Ratio of Fatigue Limit to Tensile Strength
Lab. A	EC	28,200	10,500	.37
	5005	37,350	14,000	.37
Lab. B	EC	28,200	6,800	.24
	5005	37,350	11,000	.29

The difference in stress magnitudes of the fatigue limits shown in Table 3 reflect difficulties in obtaining precision and reproducibility in fatigue testing by different laboratories. Of paramount importance at this time, however, is that the ratio of fatigue limit to tensile strength of 5005 was found by both laboratories to be equal to or greater than the ratio for EC. With this knowledge, it can be forecast that cables made of 5005 will withstand the effects of vibration at least as well as cables made of EC if the same limitations on maximum tensions under normal operating conditions, in terms of percentages of ultimate strength, are observed.

10. Notch Fatigue Sensitivity:

    Related to the matter of fatigue endurance limit is notch fatigue sensitivity. Notch fatigue sensitivity may be defined as the apparent reduction in fatigue strength caused by the presence of a sharp notch in the stressed section. The effect of a sharp notch in the stressed section is to reduce the cross section of metal available to carry the imposed load, and thereby to increase the concentration of stress at the notch above that which would otherwise be expected. In considering notch fatigue sensitivity, a most significant factor is the depth and sharpness of the notch. Since 5005 alloy is harder than EC, it is less subject to nicking or scratching, so it should be no more subject to possible damage because of notch fatigue sensitivity than EC. It is important to note that cables made of EC have an excellent record in this respect, one that is much better than is commonly realized.

11. Effect of Elevated Temperatures on Tensile Properties:

    To obtain comparative data, samples of hard drawn 5005 and EC wires have been exposed to elevated temperatures for prolonged periods of time. After exposure the loss of tensile strength at room temperature, in terms of percentage of actual strength was found to be approximately the same for the two alloys and as shown in Table 4. It should be emphasized that the losses of strength shown in Table 4 are percentages of **actual** strength, and are not percentages of specified minimum strength.

TABLE 4

Heating Time (Hours)	Heating Temperature (°C)	Loss of Strength At Room Temperature (% of Original)	
		5005	EC
100	90	3.7	4.7
100	140	14.4	13.0
1000	100	12.4	10.7

Temperatures of 90°C and higher are greater than that for which current ratings are established, and such temperatures would occur only under emergency operating conditions. Emergency conditions which may prevail are not likely to be predictable with enough accuracy to make significant any differences in loss of strength between 5005 and EC. As a practical matter, therefore, the effect on tensile strength of prolonged operation of 5005 and EC at elevated temperatures may be considered to be the same.

12. Resistance to Corrosion:
Since magnesium, the alloying constituent for 5005, has a place slightly above aluminum in the galvanic series, 5005 would be expected to be at least as resistant to corrosion as EC. 5005 has a long record in other types of uses which prove this to be true.

13. Creep Characteristics:
Laboratory tests have determined that the amount of creep, or nonelastic stretch, which occurs over a period of time in 5005 cables is about the same as that which occurs in EC cables when the two are subjected to stresses representing the same percentages of their ultimate strengths. This is reflected in the stress-strain curves for 5005 cables shown on Drawing No. 1. The total nonelastic stretch in the 5005 alloy cable, as shown on this drawing, is almost exactly the same as that for 7-strand EC cables after both have been held for a period of time at 50% or at 70% of their ultimate strengths.

14. Ductility:
Hard drawn 5005 wires of any diameter may be readily wrapped around wires of the same diameters without any evidence of fracture.

Stress-Strain Characteristics of 5005 Alloy Cables

As a result of the helical stranding, the modulus of elasticity of stranded cables is inherently different from that of solid wires. The stress-strain characteristic obtained when tension is initially applied to a cable is a curved line, while the final characteristic after tension has once been applied is a straight line. The initial and final stress-strain characteristics of 5005 alloy cables have been determined by extensive tests to be as shown on Drawing No. 1. Sag and tension values may be calculated most accurately by methods which take into account the actual shapes of stress-strain curves. Calculations can be made with a reasonable degree of accuracy by other methods which assume straight line stress-strain characteristics, however, by using a virtual value of 7.3×10^6 psi as the initial modulus and a value of 9.1×10^6 psi as the final modulus.

Physical Characteristics of 5005 Alloy Cables

The physical characteristics of

TABLE 5

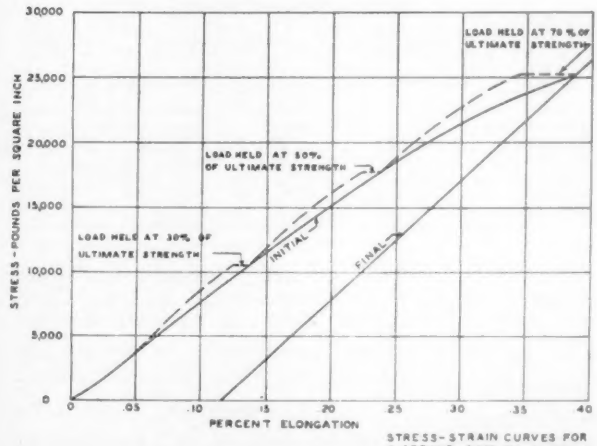
BARE 5005 ALUMINUM ALLOY SINGLE-LAYER CONDUCTORS

Code Word	Actual Area of Cross Section		EC Equiv. AWG Size	Number and Diameter of Strands	CABLE Diameter, Inches	Ultimate Strength, Lbs.	Weight per 1000 Ft. Lbs.
	CM	Sq. In.					
KAKI—BARE	48,840	.0384	#4	7 x .0835	.2505	1421	45.8
KENCH—BARE	77,640	.0610	#2	7 x .1053	.3159	2196	72.9
KIBE—BARE	123,550	.097	1/0	7 x .1328	.3984	3444	116.0
KAYAK—BARE	155,730	.1223	2/0	7 x .1491	.4473	4219	146.2
KOPECK—BARE	196,325	.1542	3/0	7 x .1676	.5028	4934	184.3
KITTLE—BARE	247,570	.1944	4/0	7 x .1881	.5643	6221	232.4

TABLE 6

BARE 5005 ALUMINUM ALLOY MULTI-LAYER CONDUCTORS

Code Word	Actual Area of Cross Section		ACSR SIZE Having Same Diameter		Number and Diameter of Strands	Cable Diameter, Inches	Ultimate Strength, Lbs.	Wt. per 1000 Ft., Lbs.
	CM	Sq. In.	MCM	Stv.				
RATCH—BARE	281,460	.2211	266.8	18/1	19 x .1217	.6085	7,064	264
RADAR—BARE	355,040	.2789	336.4	18/1	19 x .1367	.6835	8,911	333
REDE—BARE	419,450	.3295	397.5	18/1	19 x .1486	.7430	10,231	394
REX—BARE	503,340	.3954	477.	18/1	19 x .1628	.8140	11,388	473
RUBLE—BARE	587,180	.4614	556.5	18/1	19 x .1758	.8790	13,289	551
SABOT—BARE	311,120	.2444	266.8	26/7	37 x .0917	.6419	8,029	292
SCAMP—BARE	349,565	.2746	300.	26/7	37 x .0972	.6804	9,021	328
SCUD—BARE	392,470	.3083	336.4	26/7	37 x .1030	.7210	9,989	369
SEPAL—BARE	463,245	.3639	397.5	26/7	37 x .1119	.7833	11,626	435
SINE—BARE	556,050	.4368	477.	26/7	37 x .1226	.8582	13,955	522
STET—BARE	648,470	.5094	556.5	26/7	37 x .1324	.9268	16,276	609
SURAL—BARE	705,000	.5534	605.	26/7	37 x .1380	.9668	17,681	661
SPAR—BARE	740,630	.5818	636.	26/7	37 x .1415	.9905	18,065	694
SORA—BARE	824,904	.6480	715.5	26/7	37 x .1501	1.0507	20,120	775
SOLAR—BARE	927,000	.7282	795.	26/7	37 x .1583	1.1081	22,283	870



STRESS-STRAIN CURVES FOR 7-STRAND 5005 ALL ALUMINUM ALLOY CABLE
DRAWING NO. 1

TABLE 7

NEOPRENE COVERED ALL 5005 ALUMINUM CONDUCTORS

Code Word	Area of Conductor (CM)	Stranding	EC Alum. Equivalent	Diam., Inches		Covering Thickness 64ths	Breaking Strength After Covering, Pounds	Approx. Weight Lbs. Per 1000'	
				Bare	Covered			Bare	Covered
KAKI—NEO.	48,840	7 x .0835	#4	.2505	.344	3	1280	45.8	82
KENCH—NEO.	77,640	7 x .1053	#2	.3159	.410	3	1976	72.9	121
KIBE—NEO.	123,550	7 x .1328	1/0	.3984	.523	4	3100	116.0	195
KAYAK—NEO.	155,730	7 x .1491	2/0	.4473	.572	4	3797	146.2	236
KOPECK—NEO.	196,325	7 x .1676	3/0	.5028	.628	4	4410	184.3	287
KITTLE—NEO.	247,570	7 x .1881	4/0	.5643	.689	4	5599	232.4	351

TABLE 8

POLYETHYLENE COVERED ALL 5005 ALUMINUM CONDUCTORS

Code Word	Area of Conductor (Cir. Mil)	Stranding	EC Alum. Equivalent	Dia., Inches		Covering Thickness, 64th	Breaking Strength After Covering, Lbs.	Approx. Weight Lbs. Per 1000'	
				Bare	Covered			Bare	Covered
KAKI—POLY.	48,840	7 x .0835	#4	.2505	.313	2	1350	45.8	60
KENCH—POLY.	77,640	7 x .1053	#2	.3159	.409	3	2086	72.9	100
KIBE—POLY.	123,550	7 x .1328	1/0	.3984	.523	4	3272	116.0	162
KAYAK—POLY.	155,730	7 x .1491	2/0	.4473	.572	4	4008	146.2	198
KOPECK—POLY.	196,325	7 x .1676	3/0	.5028	.628	4	4687	184.3	244
KITTLE—POLY.	247,570	7 x .1881	4/0	.5643	.689	4	5910	232.4	301

TABLE 9

NEOPRENE TRIPLEX
With 5005 Aluminum Alloy Neutral
SELF-SUPPORTING ALUMINUM SERVICE DROP AND SECONDARY CABLE

Code Word	EC Phase Conductors			5005 Bare Neutral Messenger				Complete Cable	
	Size, AWG	Stranding	Cover Thickness, 64th	Size: Circular Mils	Size: EC Equiv. AWG	Stranding	Ult. Str., Lbs.	Approx. Weight, Lbs. per 1000 Feet	Diam., Inches
KAZOO—ALEWIFE	6	1 x .1620	4	30,700	6	7 x .0662	904	140	0.57
KAZOO—PERCH	6	7 x .0612	4	30,700	6	7 x .0662	904	155	0.62
KAKI—ARGENTINE	4	1 x .2043	4	48,840	4	7 x .0835	1421	199	0.66
KAKI—CARP	4	7 x .0772	4	48,840	4	7 x .0835	1421	220	0.71
KENCH—SHAD	2	7 x .0974	4	77,640	2	7 x .1053	2196	317	0.84
KIBE—KILLIFISH	1/0	7 x .1228	5	123,550	1/0	7 x .1328	3444	506	1.05
KIBE—BARRICUDA	1/0	19 x .0745	5	123,550	1/0	7 x .1328	3444	506	1.06
KAYAK—BILFISH	2/0	7 x .1379	5	155,730	2/0	7 x .1491	4219	613	1.14
KAYAK—SARDINE	2/0	19 x .0837	5	155,730	2/0	7 x .1491	4219	595	1.15
KOPECK—DOGFISH	3/0	19 x .0940	6	196,325	3/0	7 x .1676	5551	769	1.32
KITTLE—LAVARET	4/0	19 x .1055	5	247,570	4/0	7 x .1881	6221	884	1.37
KITTLE—HALIBUT	4/0	19 x .1055	6	247,570	4/0	7 x .1881	6221	933	1.43
REDUCED SIZE 5005 NEUTRAL MESSENGER									
KAZOO—NEEDLEFISH	4	1 x .2043	4	30,700	6	7 x .0662	904	182	0.66
KAZOO—TUNA	4	7 x .0772	4	30,700	6	7 x .0662	904	203	0.71
KAKI—SHARK	2	7 x .0974	4	48,840	4	7 x .0835	1421	290	0.84
KENCH—BONEFISH	1/0	19 x .0745	5	77,640	2	7 x .1053	2196	450	1.06
KILO—PAJARITO	2/0	7 x .1379	5	97,917	1	7 x .1183	2730	557	1.14
KILO—SAILFISH	2/0	19 x .0837	5	97,917	1	7 x .1183	2730	540	1.15
KIBE—CISCO	3/0	19 x .0940	5	123,550	1/0	7 x .1328	3444	657	1.25
KIBE—STEELHEAD	3/0	19 x .0940	6	123,550	1/0	7 x .1328	3444	701	1.32
KAYAK—PUMPKINSEED	4/0	19 x .1055	5	155,730	2/0	7 x .1491	4219	797	1.37
KAYAK—BULLHEAD	4/0	19 x .1055	6	155,730	2/0	7 x .1491	4219	846	1.43

TABLE 10

POLYETHYLENE TRIPLEX
With 5005 Aluminum Alloy Neutral
SELF-SUPPORTING ALUMINUM SERVICE DROP AND SECONDARY CABLE

Code Word	EC Phase Conductors			5005 Bare Neutral Messenger				Complete Cable	
	Size, AWG	Stranding	Cover Thickness, 64th	Size: Circular Mils	Size: EC Equiv. AWG	Stranding	Ult. Str., Lbs.	Approx. Weight, Lbs. per 1000 Ft.	Diam., Inches
KAZOO—PALUDINA	6	1 x .1620	3	30,700	6	7 x .0662	904	103	0.52
KAZOO—VOLUTA	6	7 x .0612	3	30,700	6	7 x .0662	904	111	0.56
KAKI—WHELK	4	1 x .2043	3	48,840	4	7 x .0835	1421	155	0.60
KAKI—PERIWINKLE	4	7 x .0772	3	48,840	4	7 x .0835	1421	165	0.65
KENCH—CONCH	2	7 x .0974	3	77,640	2	7 x .1053	2196	252	0.78
KIBE—MERITINA	1/0	7 x .1228	4	123,550	1/0	7 x .1328	3444	412	0.99
KIBE—CENIA	1/0	19 x .0745	4	123,550	1/0	7 x .1328	3444	398	1.00
KAYAK—RUNCINA	2/0	7 x .1379	4	155,730	2/0	7 x .1491	4219	499	1.08
KAYAK—TRITON	2/0	19 x .0837	4	155,730	2/0	7 x .1491	4219	490	1.09
KOPECK—MURSIA	3/0	19 x .0940	4	196,325	3/0	7 x .1676	4934	607	1.19
KITTLE—ZUZARA	4/0	19 x .1055	4	247,570	4/0	7 x .1881	6221	753	1.31
REDUCED SIZE 5005 NEUTRAL MESSENGER									
KAZOO—SCALLOP	4	1 x .2043	3	30,700	6	7 x .0662	904	138	0.60
KAZOO—STROMBUS	4	7 x .0772	3	30,700	6	7 x .0662	904	149	0.65
KAKI—COCKLE	2	7 x .0974	3	48,840	4	7 x .0835	1421	224	0.78
KAKI—GEBIA	2	7 x .0974	4	48,840	4	7 x .0835	1421	240	0.83
KENCH—JANTHINA	1/0	7 x .1228	4	77,640	2	7 x .1053	2196	369	0.99
KENCH—RANELLA	1/0	19 x .0745	4	77,640	2	7 x .1053	2196	355	1.00
KILO—CAVOLINA	2/0	7 x .1379	4	97,917	1	7 x .1183	2730	451	1.08
KILO—CLIO	2/0	19 x .0837	4	97,917	1	7 x .1183	2730	435	1.09
KIBE—AEGA	3/0	19 x .0940	4	123,550	1/0	7 x .1328	3444	539	1.19
KIBE—PISA	3/0	19 x .0940	5	123,550	1/0	7 x .1328	3444	562	1.25
KAYAK—CERABUS	4/0	19 x .1055	4	155,730	2/0	7 x .1491	4219	666	1.31
KAYAK—NEPATUS	4/0	19 x .1055	5	155,730	2/0	7 x .1491	4219	692	1.37

TABLE 11

NEOPRENE DUPLEX

SELF-SUPPORTING ALUMINUM SERVICE DROP AND SECONDARY CABLE
(Neoprene covered phase conductors, bare neutral messenger)

5005 ALUMINUM ALLOY NEUTRAL MESSENGER

Code Word	EC Phase Conductors			5005 Bare Neutral Messenger				Complete Cable	
	Size, AWG	Stranding	Cover Thickness, 64th	Size: Circular Mil	Size: EC Equiv., AWG	Stranding	Ultimate Strength, Lbs.	Approx. Wt., Lbs Per 1000 Ft.	Diam., Inches
KAZOO—SPITZ	6	7 x .0612	4	30,700	6	7 x .0662	904	93	0.507
KAZOO—SAMOYED	6	1 x .1620	4	30,700	6	7 x .0662	904	85	0.486
KAKI—BEAGLE	4	7 x .0772	4	48,840	4	7 x .0835	1421	137	0.608
KAKI—ST. BERNARD	4	1 x .2043	4	48,840	4	7 x .0835	1421	126	0.561
KENCH—GREYHOUND	2	7 x .0974	4	77,640	2	7 x .1053	2196	196	0.733
KILO—DALMATIAN	1	19 x .0664	5	97,917	1	7 x .1183	2730	249	0.843
KIBE—CHESAPEAKE	1/0	19 x .0745	5	123,550	1/0	7 x .1328	3444	305	0.928

TABLE 12

POLYETHYLENE DUPLEX

SELF-SUPPORTING ALUMINUM SERVICE DROP AND SECONDARY CABLE
(Polyethylene covered phase conductors, bare neutral messenger)

5005 ALUMINUM ALLOY NEUTRAL MESSENGER

Code Word	EC Phase Conductors			5005 Bare Neutral Messenger				Complete Cable	
	Size, AWG	Stranding	Cover Thickness, 64th	Size: Circular Mil	Size: EC Equiv., AWG	Stranding	Ultimate Strength, Lbs.	Approx. Wt., Lbs. Per 1000 Ft.	Diam., Inches
KAZOO—SETTER	6	1 x .1620	3	30,700	6	7 x .0662	904	66	0.434
KAZOO—SHEPHERD	6	7 x .0612	3	30,700	6	7 x .0662	904	71	0.476
KAKI—TERRIER	4	7 x .0772	3	48,840	4	7 x .0835	1421	106	0.576
KAKI—ESKIMO	4	1 x .2043	3	48,840	4	7 x .0835	1421	103	0.549
KENCH—CHOW	2	7 x .0974	3	77,640	2	7 x .1053	2196	163	0.702
KILO—LABRADOR	1	19 x .0664	4	97,917	1	7 x .1183	2730	207	0.812
KIBE—BULL	1/0	19 x .0745	4	123,550	1/0	7 x .1328	3444	257	0.896

TABLE 13

NEOPRENE QUADRUPLEX

SELF-SUPPORTING ALUMINUM SERVICE DROP AND SECONDARY CABLE
(Neoprene covered phase conductors, bare neutral messenger)

5005 ALUMINUM ALLOY NEUTRAL MESSENGER

Code Word	EC Phase Conductors			5005 Bare Neutral Messenger				Complete Cable	
	Size, AWG	Stranding	Cover Thickness, 64th	Size: Circular Mil	Size: EC Equiv., AWG	Stranding	Ultimate Strength, Lbs.	Approx. Wt., Lbs Per 1000 Ft.	Diam., Inches
KAZOO—BRAHMAN	6	1 x .1620	4	30,700	6	7 x .0662	904	196	0.75
KAKI—RED POLLED	4	1 x .2043	4	48,840	4	7 x .0835	1421	275	0.88
KAKI—JERSEY	4	7 x .0772	4	48,840	4	7 x .0835	1421	306	0.94
KENCH—HEREFORD	2	7 x .0974	4	77,640	2	7 x .1053	2196	439	1.12
KILO—GUERNSEY	1	19 x .0664	5	97,917	1	7 x .1183	2730	565	1.30
KIBE—KERRY	1/0	19 x .0745	5	123,550	1/0	7 x .1328	3444	679	1.42
KAYAK—DEXTER	2/0	19 x .0837	5	155,730	2/0	7 x .1491	4219	819	1.55
KOPECK—HIGHLAND	3/0	19 x .0940	5	196,325	3/0	7 x .1676	4934	993	1.70
KITTLE—LONGHORN	4/0	19 x .1055	5	247,570	4/0	7 x .1881	6221	1207	1.86

TABLE 14

POLYETHYLENE QUADRUPLEX

SELF-SUPPORTING ALUMINUM SERVICE DROP AND SECONDARY CABLE
(Polyethylene covered phase conductors, bare neutral messenger)

5005 ALUMINUM ALLOY NEUTRAL MESSENGER

Code Word	EC Phase Conductors			5005 Bare Neutral Messenger				Complete Cable	
	Size, AWG	Stranding	Cover Thickness, 64th	Size: Circular Mils	Size: EC Equiv., AWG	Stranding	Ultimate Strength, Lbs.	Approx. Wt., Lbs. Per 1000 Ft.	Diam., Inches
KAZOO—MOROCHUCA	6	1 x .1620	3	30,700	6	7 x .0662	904	160	0.69
KAKI—HACKNEY	4	7 x .0772	3	48,840	4	7 x .0835	1421	226	0.87
KAKI—MORGAN	4	1 x .2043	3	48,840	4	7 x .0835	1421	214	0.83
KENCH—PALOMINO	2	7 x .0974	3	77,640	2	7 x .1053	2196	340	1.04
KILO—ALSINO	1	19 x .0664	4	97,917	1	7 x .1183	2730	437	1.23
KIBE—COSTENA	1/0	19 x .0745	4	123,550	1/0	7 x .1328	3444	538	1.34
KAYAK—GRULLO	2/0	19 x .0837	4	155,730	2/0	7 x .1491	4219	662	1.49
KOPECK—SUFFOLK	3/0	19 x .0940	4	196,325	3/0	7 x .1676	4934	818	1.65
KITTLE—APPALOOSA	4/0	19 x .1055	4	247,570	4/0	7 x .1881	6221	1012	1.90

bare, neoprene covered and polyethylene covered 5005 alloy cables in sizes having equal d.c. resistance to EC sizes AWG No. 4 through 4/0 are shown on Tables 5, 7 and 8. Adjustments in strength due to the heat of covering have been made in Tables 7 and 8 even though reductions in strength have not actually been observed in tests.

★ ★ ★

The physical characteristics of bare multi-layer 5005 alloy cables are shown in Table 6. The standard multi-layer sizes were designed to have the same outside diameters as standard sizes of 18/1 and 26/7 ACSR. This was done so that accessories already available for ACSR will fit the 5005 cables also.

★ ★ ★

Cables made of 5005 are ideal as

(*Please turn to page* 1525)

The Organisation and Application of Plant Maintenance in a Wire Works

by G. D. Rendel
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This paper was presented at the Staff School of Frederick Smith & Co. Wire Manufacturers Ltd., which is conducted at its Caledonia Works in Halifax, England. For it Mr. Rendel received an Administrative Section Award. He was educated at Winchester and Magdalene Colleges from which latter he holds a B.S. Degree in Engineering. He joined Rylands Brothers in 1949 as Assistant to the Chief Engineer and was made Plant Engineer in 1953. The paper is published through the courtesy of Frederick Smith & Co.

Introduction

It would be difficult to find an industry in which there is a wider diversity of plant than is to be found in a Wire Works. Almost all aspects of engineering are involved from medium to light and ranging into the field of chemical and electronic engineering.

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The volume of production is directly proportional to the plant available as the production labour ratio is generally low, hence plant availability is the key to high production.

★ ★ ★

Thus there is a vital need for a comprehensive Engineering Department to cover all aspects of maintenance. The aim of this paper is to outline the organization and how it is deployed and applied.

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Three main points dictate the whole approach to the problem of plant maintenance:

(a) The Engineering Department must be a Service Department with service as the key word.

(b) Plant availability of 100% must always be the target.

(c) The plant must be maintained with a very sharp eye on cost. The cost of engineering services is an important part of the cost of a product and profligate maintenance can very easily inflate costs.

Facts and Figures

Acreage of Works	36
Weekly Production	3,000 tons
Number of employees (excluding staff)	1,900
Engineering Employees	230
Engineering Staff	25
Electrical Load	9,000 KW
Gas consumption	7,000,000 cubic ft. per week.
Steam consumption	30,000 lbs. per hour.
Plant Working	3 shift, 6½ days per week (average).

The Plant

A brief description of the plant involved is necessary to demonstrate the problem of maintenance.

★ ★ ★

There are seven main types of machinery and equipment that must be considered:

(a) Handling. This is placed first as it is the key to production. A crane stoppage can mean a great deal of lost production. Some 125 overhead cranes from 10 ton to 5 cwt. are involved, the majority on three shift continuous working. 25 ram trucks, diesel and electric, are also in continuous use.

(b) Cleaning. There are two cleaning houses—one sulphuric and one hydrochloric. The sulphuric house is complete with acid recovery plant and lip extraction of fume, the main items for maintenance being pumps, pipe lines, flash ovens and cleaning tanks.

(c) Drawing Machinery. There are approximately 575 blocks varying from single hole bull blocks for 1" diam. to multihole fine wire machines drawing down to 26 gauge, the major producing units being multihole A. C. continuous drawing machines.

(d) Annealing. There are approximately 2000 KW of electric annealing plants of the Birlec type with inert atmosphere plants, (cracked ammonia and cracked town gas) and ancillaries such as loading stands, coil carriers and instrumentation.

(e) Galvanising. A plant consisting of eight 20 end electro galvanising cells is the main production unit. This plant is the largest single maintenance problem to be dealt with involving 10 motor generating sets of some 4000 KW. The plant itself consisting of lead lined cells with all lead lined piping for electrolyte; gas fired lead baths, cleaning trains and winding frames.

The leaching plant for electrolyte involves large capacity tanks, filters and oil storage plant. This is very largely a chemical plant.

In addition there are two 40 end hot dip galvanising plants with gas fired lead galvanising baths, cleaning trains, fume extraction and winding frames.

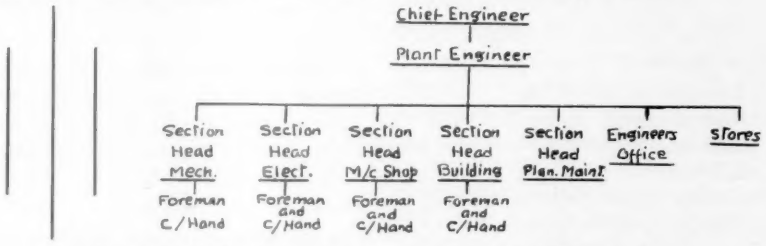
Eight fine tinning and galvanising plants of varying capacity are housed in a special Tinning Department.

(f) Fabricating. There are individual shops for fabricating the following: nails, netting, chain link fence, hinge joint fence, barb, upholstery springs and straight lengths.

(g) General. This embraces the various plant encountered in all engineering works—boilers, pumps, compressors, etc.

The Maintenance Team

A clearly defined supervisory organization is essential. A vague one only leads to a "Who do I see to get this done?" complex amongst production men.



Establishments

The number of men required efficiently to maintain any particular part of the plant is determined by its size, its complications, its geographical location, and the

planned maintenance system described below has been found generally to be the most economical method. With this in view, "establishments" giving the number of men, their specialist qualifications and their jobs, is a necessity. It is essential to the organization to adhere to the establishments laid down.

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Because of the distance between various parts of the works, it has been found convenient to divide the whole up into maintenance zones. To each is allocated a team suitable for the machinery installed and the maintenance involved.

Office Organization

A small centralised office deals with all the day to day paper work concerning the departments, such as requisitions for labour, materials, sick notes, accident reports and general correspondence. This releases the foremen from a great amount of unnecessary desk work; a foreman tied to a desk is of little use.

The Application

Maintenance, in which is included electrical, mechanical and building, for the purposes of this examination is divided into six headings:

Planned
Permanent
Periodic
Annual
Breakdown
Contract

Planned Maintenance

This is the mainstay of the whole maintenance system.

★ ★ ★

As a great many detailed and published papers on various plant maintenance systems are available, in this paper only a limited description will be given.

Principles

(a) Detailed inventory of all plant requiring regular maintenance.
(b) Careful study of type of maintenance required.
(c) Determination of frequency of maintenance.
(d) Determination of actual time required for maintenance.
(e) Office System to provide automatic means of seeing that this is done.
(f) Analysis of breakdown percentage etc. to enable an incentive bonus to be paid.

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The application of the system will be briefly described.

★ ★ ★

All instructions for maintenance operations are issued on individual cards indicating the frequency, (i.e. daily, weekly or monthly) the trade involved, (fitters, electricians, labourers or oilers and greasers) and the time allowed. These are issued by the Planned Maintenance Office from inspection of a visual index system.

★ ★ ★

These cards are issued to the foremen concerned and passed to the men involved. After the requisite maintenance has been carried out the card is filled in on the reverse by the man concerned and, with the foreman's signature, is returned to the Planned Maintenance Office. Here the cards are completed for the purposes of bonus calculation and any necessary action indicated by the reports is taken.

★ ★ ★

In all some 75% of the whole plant is covered by this system and some 2,000 cards are issued from the office weekly.

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It must be clearly stated however that foremen must be keen to check frequently that jobs are correctly done and not skimped.

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This system cannot of course be applied to all plant and exceptions are catered for in the various other types of maintenance which are enumerated below.

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It does however take a great load off supervision but it is most essential for the operation of plant maintenance that there is a meticulous follow-up and check by the foremen concerned.

★ ★ ★

This system can, with great advantage, be extended to many minor items such as canteen cooking equipment, floor cleaning equipment and systematic cleaning of lamp shades. The last is strongly recommended as lighting efficiency tails off rapidly with dirty light shades.

★ ★ ★

A very great deal of ground work is necessary to introduce such a system but once introduced considerable reduction of labour can be achieved and plant efficiency increased.

★ ★ ★

Two detailed examples of planned maintenance are:

(a) Fitters' Weekly Examination of Stockyard Crane.

Examine and tighten bearings on transmission shaft. Check bearings for wear by gently levering shaft at each bearing and noting play. Examine couplings, tighten bolts, check for play etc. Examine track and crab wheels, check that crab wheel flanges are clear of girders. Report diameters of drive wheels on time card. Tighten all bolts on track wheels, crab bearings, winch etc. Examine gears on transmission shaft and track wheels, also drive gears on crab drive, report worn or broken teeth. Check keys for play, adjust as required. Examine winding drum, report excessive wear or grooving. Check all bearings and gear box for lubrication. Report defects on Time Card.

(b) Electricians' Weekly Examination of A.C. Contactor Panel for 8 Hole Machine.

Open isolating switch, remove fuses from distribution box. Examine and clean isolating switch contacts. Examine brake switches, overload assemblies, low speed contactors etc. Check and examine all contactor tips, check springs, clean magnet faces, trim contactor tips with smooth file, replace if badly worn or pitted. Check leads and replace as required. Lubricate bearings points on overloads and slight lubrication of bearing points on Main Contactors. Examine interlocking switch, pillar release switch and tighten pillar if loose, assemble switch and reset. Lubricate push button stems. Refit fuses etc., check machine under load.

Incentive Maintenance Bonus Calculation

The method of calculating bonus earnings is derived from two sources, plant efficiency and man hour efficiency.

★ ★ ★

(a) Weighted efficiency is obtained by dividing the actual efficiency of the plant by target efficiency. The actual efficiency is

obtained from production lost hours sheets provided by Production Departments, e.g. if there are say 100 blocks in a mill working for 44 hours and ten blocks are stopped for 4 hours each, then the lost hours are 40, the possible hours 440 and hence the actual efficiency $\frac{400}{440}$, i.e., 91%.

★ ★ ★

The target efficiency is a theoretical maximum obtained from past records and study.

$$\therefore \text{Weighted Efficiency} = \frac{\text{Actual Efficiency}}{\text{Target Efficiency}}$$

★ ★ ★

This weighted efficiency gives the bonus rate per 44 hours from a graph plotted to enable a craftsman to earn from 36/— to 42/— per 44 hours.

★ ★ ★

(b) The man hour value efficiency is obtained by dividing the teams' (c.f. Establishments) hours as allowed on the job cards by the actual hours taken.

$$\therefore \text{MHV Efficiency} = \frac{\text{Hours allowed}}{\text{Hours taken}}$$

★ ★ ★

This efficiency is then multiplied by the weighted efficiency bonus above to give the bonus earned for a 44 hour week.

$$\therefore \text{Bonus Rate} = \text{MHV Efficiency} \times \text{Weighted Efficiency Bonus Rate.}$$

★ ★ ★

It can be seen that from this bonus system an increase in breakdowns will decrease a man's bonus earnings and vice versa. Although with the present day high engineer's rates, a variation of ± 5/— per 44 hours may not seem a great incentive, in practice it has shown to be a valuable contributory factor to a high plant efficiency.

Periodic Maintenance

This heading covers the day to day maintenance that is not catered for by any planned maintenance and it is in fact the remainder of the old time "Little Black Book" maintenance which planned maintenance has now largely obviated.

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It is however extremely important but very difficult to organise, being very largely the individual responsibility of the foremen concerned.

★ ★ ★

This would be an adequate point in this paper to stress the importance of having really competent and skilled men in the position of engineering foremen both electrical and mechanical. They must be prepared to take on the spot decisions as to whether a plant is safe, is fit to run or not; in many ways they can save or lose the firm a lot of money.

★ ★ ★

Day to day maintenance as requested by production managers and foremen is covered by the issue of service notes from the Production Departments but more frequently by word of mouth between engineering foremen and production foremen.

★ ★ ★

For the larger items of maintenance, the approach involves anticipating trouble and regular inspection and overhaul where necessary. For instance, for continuous running plant, certain items such as pumps, motors, compressors, etc., inevitably require overhaul. In such cases spares must be got ready in advance and any available opportunity seized to take the plant from production for overhaul. This in the main involves overtime and weekend working, a necessary expense which continuous plant has to bear.

Permanent Maintenance

There is a considerable amount of plant which cannot in practice be covered by planned maintenance. In the main this applies to wire products' machinery, i.e. nail machines, barb machines etc., where continuous attention is required.

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In this case the particular department is allocated the requisite amount of labour which is located permanently in the department and which specialises in the particular type of plant.

★ ★ ★

As an example, two fitters working on two twelve hour shifts can maintain, change and set 24 barb machines.

★ ★ ★

This system is extremely advantageous and where applied, in the main produces a very high plant availability figure.

★ ★ ★

In this connection it has been found desirable to centralise the maintenance and overhaul of all electric ram trucks in one shop where a fitter and an electrician are permanently employed as specialists.

Annual

The annual two weeks stoppage is a boon to the engineer and into two weeks has to be crowded all the vital repairs and renewals to last for the next year.

★ ★ ★

A programme for stoppage must be prepared well in advance so that all the necessary tackle and spares are available.

★ ★ ★

For instance the replacement of overhead crane tracks, such as for stockyard cranes, can only be done during stoppage period.

★ ★ ★

Galvanising plants and cleaning houses are two big items of plant which have to be overhauled and spring cleaned during stoppage period. Frequently this type of overhaul involves fairly large scale building and plant alterations which must all be organised well in advance to enable the work to be completed in the two weeks available.

★ ★ ★

Advantage of the annual stoppage must also be taken for the overhaul of H.T. and L.T. switchgear and transformers. There is probably no more vital piece of plant in a works so dependent on electrical supply than the various substations. Here a planned programme, worked out over the years in co-operation with the local Electricity Board, is quite essential.

Breakdown Maintenance

This is of course largely self ex-

planatory. Breakdowns are inevitable however carefully plant is maintained.

★ ★ ★

A big breakdown is the testing time of any maintenance engineering department and it is here that team spirit and co-operation both between management, men and trade pay handsome dividends.

★ ★ ★

A burst galvanising bath is a good example to quote where fitters, bricklayers, navvies have to work almost on top of each other under very difficult conditions to get the old bath emptied, removed and a new one inserted. Here is a good point to mention how invaluable a good team of navvies or "the heavy gang" is to the engineering department. There is practically no job, however unpleasant or tough, that they will not tackle and they are seldom beaten.

Contract

There are certain items of plant which are better maintained on a contract basis. Examples are weighing machines, office machinery, time clocks etc. All these require specialised knowledge and it is not economical to train permanent staff to do these jobs.

★ ★ ★

It is usual to find that good service can be obtained as the servicer's product is at stake. The inventory of items covered by service contracts must be rigorously maintained and a clear record of the contracts themselves is essential in order that additions and removals are duly covered.

★ ★ ★

The above categories have dealt basically with maintenance; there are however ancillary services which are very much involved.

Spares Organisation

A centralised stores is undoubtedly a great asset.

★ ★ ★

Good storekeeping is essential to keep plant running and the storekeeper must avoid overstocking but must never run low. This is particularly difficult at a time when steel deliveries affect so many spare parts.

★ ★ ★

On spares in general, wherever propietory spares are available they are obtained; there are however a very considerable quantity of spares which must be made in our own shops.

★ ★ ★

These spares are all carefully coded, with reference to the drawing concerned, and recorded in a running inventory system. Orders are placed in the machine shop in advance, depending on Machine Shop loading. Here co-operation between stores and machine shop is essential.

★ ★ ★

It is advisable to have a fairly detailed office system for this as the majority of spares involve different materials, several different machining operations and, in many cases, heat treatment. An order form following it right through to the final article is issued from the stores and the detail of material etc., is filled in in the machine shop. An additional copy is sent to the Cost Department so that the spare can be priced and charged to whichever department uses it.

★ ★ ★

A central oil stores is important. A great deal of harm can be caused by the use of dirty oil, this is frequently the resultant of a clutter of half full drums of different oils in the various shops.

★ ★ ★

It is possible to standardise on about 16 grades of oil and grease, consequently bulk stocks can be carried and issued in small quantities as required. Grease particularly should be issued in small tins with suitable dispensing devices.

★ ★ ★

New equipment should be vetted for the type of oil required and where a non standard make or grade is recommended, the representative of the oil company concerned is asked to quote for an equivalent.

Machine Shop

This, it is considered, must be equipped to tackle all aspects of machine shop practice with the exception of heavy machinery such as boring and large diameter turning where the amount of work involved does not justify the capital expenditure on a special machine tool.

★ ★ ★

The type of work to be catered for is extremely varied and ranges from precision grinding on press tools for the die shop to the turning of large diameter galvanising rollers or planing of machine beds.

★ ★ ★

All work is on a piece work basis which is set by a rate fixer.

★ ★ ★

Jobs are classified into three heads:

(a) Plant stopped jobs,
(b) Spares,
(c) New Work,

and are dealt with in that priority. Here again all machine tools are centralised in one shop and a better class of work and higher efficiency results.

Ancillaries

In addition to the above, the following ancillary trades are a vital adjunct to the maintenance team.

★ ★ ★

Blacksmiths. Two blacksmiths can adequately cover all the work required. Blacksmiths as such are rapidly becoming rare and fabrication and welding are to a large extent taking their place. There will however always be a need for a jobbing blacksmith for all types of hooks, drop bars etc., required in cleaning houses, galvanising shops etc.

★ ★ ★

Tinsmith Shops. This, too, is extremely necessary since the Factory Act and the general improved standard of working conditions calls for more and more sheet metal work. Guards, fume hoods, exhaust ducting, oil drip trays—all these items are an essential to the good condition of the plant generally.

NEWS OF INTEREST TO THE WIRE AND CABLE INDUSTRY VOL. III No. 6

WIRE Recorder

T.M. REG. U.S. PAT. OFF. MONSANTO CHEMICAL CO.

PUBLISHED BY MONSANTO CHEMICAL CO., PLASTICS DIVISION, SPRINGFIELD, MASS.

Monsanto

British Commonwealth Cable Network to Circle Globe

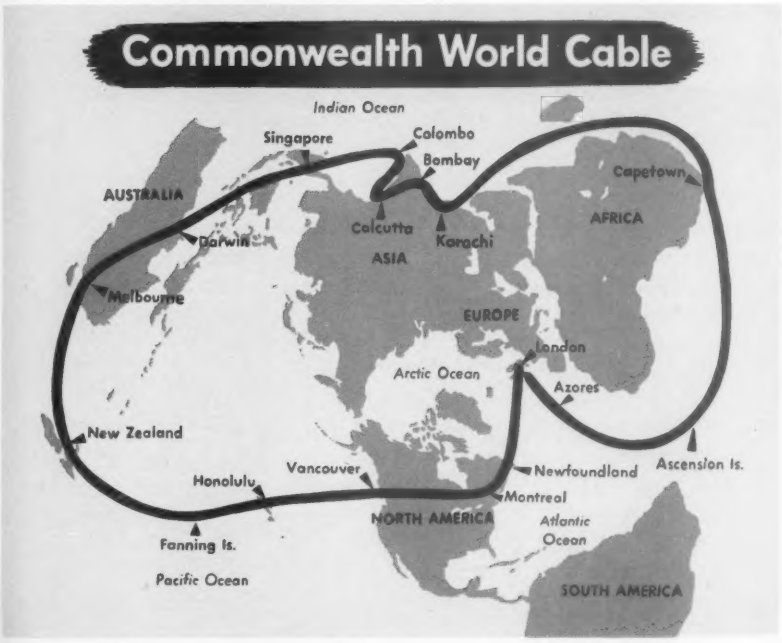
A $250 million system of communications will join all members of the British Commonwealth of Nations within the next ten years. Agreement for participation in the network, which will circle the globe providing instant contact between each country in the Commonwealth, was announced recently at The Commonwealth Trade and Economic Conference held in Montreal. The proposal for the cable system was made by Canada's Minister of Finance, Donald Fleming, chairman of the conference.

The network, scheduled to be completed within the next ten years, will utilize an existing cable, plus a new one to be laid between Britain and Canada by 1961. From Canada the cable will connect with New Zealand by way of Honolulu. Australia; Chittagong, East Pakistan; Colombo, Ceylon; Bombay, India; and Karachi, West Pakistan, will all be joined by the cable which will then stretch around the coast of Africa to England.

The venture is planned as a profit-making project with much of the estimated $250 million cost to be paid by Britain.

The cable system, when completed, will utilize repeaters to provide 100 per cent reception throughout. Telephone, telex, cable and photo-telegram facilities will be included. At the present time radio-telephone communications already circle the globe; however, they are subject to ionospheric disturbances.

The first new link in the system will connect Vancouver, British Columbia, with Melbourne, Australia.



Canadians Build Powerhouse in Mountain

Rapidly nearing completion, deep inside a mountain in northern Quebec, is one of the most spectacular power developments ever constructed in the western hemisphere.

An undertaking of the Aluminum Company of Canada, the power project is located at Chute-des-Passes, approximately 200 miles north of the city of Quebec. When completed it will generate electricity by the million-horsepower (746,000 kilowatt), to be transmitted over two high-voltage lines to Isle Maligne, some 100 miles south, where it will be used to feed the power network of the company.

Begun two years ago at a budget of $150 million (which has been pared down to $140 million), the five huge generators of the installation are located in a powerhouse deep inside a mountain. The powerhouse itself is more than ten stories high and half again as long as a football field. The turbines will be operated by water from the Peribonka Lake rushing through a tunnel nearly six miles long,

(*continued on page 4*)

Opalon 1444 Meets Requirements of MIL-W-16878 . . . Type D — 6

Monsanto vinyl compound, Opalon 1444, has been completely characterized for use on MIL-W-16878, Type D — 6 high temperature insulated wiring used primarily in aircraft applications. Type D — 6 represents the largest construction covered by this government specification. Opalon 1444 is already being widely used on Types B, C and smaller sizes of Type D.

Following are details on the extensive electrical and physical tests used in accordance with paragraphs 4.4.2.1 through 4.4.2.9 of MIL-W-16878.

(*see chart on page 3*)

MONSANTO WIRE RECORDER
newsletter
Monsanto

NEW RESEARCH CENTER FOR ELECTRONICS OPENED BY RCA - A large new multimillion dollar research center has been opened at Burlington, Massachusetts, by the Radio Corporation of America. The center has been designed for research, development and production of electronic devices and systems for missiles and space vehicles. John L. Burns, President of RCA, expressed the belief that electronics will become New England's biggest industry within the next twelve years...with sales totaling more than $3 billion annually.

* * *

SOVIETS INDICATE THEY HAVE WORLD'S LARGEST ATOM POWER PLANT - Russian scientists revealed recently that they are now operating a 100,000 kilowatt nuclear power plant somewhere in Siberia. The largest U.S. power reactor located at Shippingport, Pennsylvania, is rated at some 60,000 kilowatts. However, the steam temperature of U.S. plants is considerably higher than that of the Soviets. Steam temperature of reactors determines efficiency, with the higher temperature providing greater efficiency.

* * *

RADIOS NOW TRACK DANGEROUS STORMS - Hurricanes of the future will have a difficult time evading weathermen due to a new method of automatic tracking. As an experiment, a balloon-borne radio beacon was placed in the eye of a tropical storm last Fall. A radio transmitter flashed a continuous report on the movement of the storm for several hours after being dropped into the storm's calm eye. A project of the National Weather Bureau and the Geophysics Research Directorate of the Air Force Research Center in Cambridge, Massachusetts, the experiment climaxed a year's development in radio-tracking of hurricanes.

* * *

ELECTRONICS OPERATE NEW PLANT - Ford Motor Company recently completed a new engine plant at Lima, Ohio, where electronics and automation work hand in hand to operate the most advanced engine plant in the industry. A firm believer in automation for many years, the major difference in the Lima, Ohio, plant from its predecessors is in the extended use of electronics which operate proximity switches, quality control gages, and balanced crankshafts and completed engines. Maintenance is minimized because of the elimination of moving parts in the operation.

* * *

TWO ENGINES FOR NEW CARS? - With a growing number of accessories being installed on new model cars, it is beginning to look as though the second engine may become a necessity to take care of the additional load. General Motors newest experimental model, Firebird III, has been equipped with a small constant-speed auxiliary engine designed as a companion to the vehicle's turbine prime mover. The second engine has been designed to power the hydraulic system and to drive a 110-volt generator which provides 60-cycle electric power.

* * *

EURATOM BILL PASSED, PROVIDING $328 MILLION IN U.S. AID TO SIX-NATION EUROPEAN ATOMIC COMMUNITY - Nuclear power plants totaling one million kilowatts of capacity will be constructed with U.S. aid by 1963. The Westinghouse Corporation was the first to announce participation in the project with the establishment of Westinghouse International Atomic Power Company in Geneva, Switzerland.

CONSTRUCTION DETAILS

Cable Size	#6	Conductor Diameter	0.208″
Type of Conductor	Stranded	Outside Cable Diameter	0.289″
No. of Strands	133	Wall	0.041″
Strand Diameter	0.0142″		

TEST	TEST DETAILS	CONDITIONING	SPECIFIED REQUIREMENTS	RESULTS
4.4.2.1 Dielectric Strength	Specification MIL-C-915 test procedures.	Immersed 2 hrs. in tap water at 25°C.	7.0 KV minimum	Withstand 7 KV for 1 min. Dielectric breakdown greater than 25 KV.
Insulation Resistance	Specification MIL-C-915 test procedures.	Immersed 2 hrs. in tap water at 25°C.	30 megohms/1000 feet minimum	1960 megohms/1000 feet
4.4.2.2 Conductor Resistance	Specification MIL-C-915 test procedures.	------	------	Test not run.
4.4.2.3 Physical Properties 1. Original Tensile Properties 2. Retention of Tensile Properties After Aging	Tensile properties determined on buffed specimens with Instron Tensile Tester. Buffing necessary to remove irregularities of inner surface.	1. As received, no special conditioning 2. Buffed specimens aged 96 hrs. at 136°C. in gravity convection oven	1. Elongation 100 min. Tensile Strength 1200 psi min. 2. Elongation 90% min. Tensile Strength 50% min.	1. Elongation 262% Tensile Strength 2983 psi 2. Elongation 96.2% Tensile Strength 105%
4.4.2.4 Heat Resistance	Construction wrapped 5 turns around 1″ dia. mandrel. Dielectric strength determined after 1 hr. in room temperature tap water.	96 hrs. at 150°C. in circulating air oven	1/8″ max. shrinkage of insulation 7 KV min. dielectric strength	Shrinkage 1/64″ Withstand 7 KV for 1 min. Dielectric breakdown greater than 25 KV.
4.4.2.5 Cold Bend	A single 180° turn around 10″ mandrel at the rate of 15 rpm. Dielectric strength determined after 1 hr. immersion in room temperature tap water.	4 hrs. at −54°C. temperature conditioning As received, no special conditioning	No physical derangement conditioning 7 KV min. dielectric strength	No cracks, fissures or other physical imperfections. Withstand 7 KV for 1 min. Dielectric breakdown greater than 25 KV.
4.4.2.6 Soldering	6″ test specimens with 1/2″ insulation removed from one end. One 90° bend at a point 1/2″ from ends of insulation. End of specimens immersed for 5 seconds within 1/8″ of insulation in 60/40 tin lead solder maintained at approximately 320°C.	As received, no special conditioning	1/8″ max. shrinkage of insulation The insulation shall not flare from conductor or open up at the bend	Shrinkage 1/32″ No flaring or opening up
4.4.2.7 Flammability	Specimen held over burner at 45° angle for 30 sec.	As received, no special conditioning	3″ max. flame travel 30 sec. max. burning time	Flame travel 1″ Burning stopped immediately when flame source withdrawn
4.4.2.8 Dielectric Constant & Power Factor	External surface of sample grounded by silver paint. Power factor and capacitance determined by bridge method at room temperature and at 1 megacycle/second.	As received, no special conditioning	No requirement	Dielectric Constant 3.10 Power Factor .0478
4.4.2.9 Surface Leakage	Two 1/4″ bands of metal foil positioned 1″ apart on surface of cable. Surface retention measured with DC potential of 200-300 volts while still in conditioning chamber. After 2500 volts AC for one minute and 20 minute discharge surface retention is measured again.	Humidity conditioning 96 hrs. at 25°C. and 95% relative humidity	Surface resistance 5 megohms min. Change from initial value after subjection to potential ±50% max.	Surface retention 9.75×10^6 megohms % Change 3%

(cont'd from page 1)

Canadians

blasted out of solid granite. In addition three access tunnels and an outlet tunnel of nearly two miles make up a subterranean network of some ten miles. The main tunnel, measuring thirty-four feet in diameter, dwarfs the size of New York's Holland Tunnel. The discharge tunnel, which is even larger, measures forty-eight feet.

The first generators of the plant will begin producing power by next August, and by March 1960 the project will be entirely completed. Periodic shortages of hydroelectric power have hampered the operations of the Aluminum Company in recent years, particularly in the early spring before the ice and snow of the area have melted. The new plant will supply enough power for the company to expand its aluminum capacity from its present figure of 550,000 tons to some 770,000 tons a year when necessary, and it will still be able to supply the electrical power needs of the surrounding area.

DEW Line Vital Link in Nation's Defense System

With world tensions remaining at a high level, the nation's vitally important system of advance warning of enemy attacks is taking on added emphasis and importance. The most important single link in this system of early warnings is the Distant Early Warning Line completed last year.

The DEW Line, which is located in northern Canada, stretches some 3,000 miles from Baffin Island on the Atlantic Coast to Alaska on the west. The Line is comprised of a string of highly sensitive radar stations which are manned around the clock to alert the entire North American continent in the event of the approach of enemy bombers heading toward the cities of the United States or Canada. Even with today's top-speed jet bombers, traveling at the speed of sound, the advance warning from the DEW Line would precede enemy aircraft by at least one hour before they could reach their nearest potential targets.

The Line is maintained and operated by the Federal Electric Corporation of Paramus, New Jersey, a service organization of the International Telephone and Telegraph Corporation. In addition to the DEW Line itself, a mid-Canada Line at the 55th parallel and a Pine Tree Line just north of the U.S.-Canadian border complete the northern sector of the nation's defense system. These Lines are supplemented along the Atlantic, Pacific and Gulf coasts with a closely integrated system of "Texas Towers," radar ships and planes patrolling the coastal waters to form a protective electronic web around the entire North American continent.

The Federal Electric Corporation operates the DEW Line under a contract with the U.S. Air Force, and also maintains an integrated civilian-military radio and telephone communications system in Alaska under a similar arrangement.

FEC civilian technicians man the DEW Line working closely with Air Force personnel who evaluate the information that the technicians observe on their radar screens. Although the amount of information concerning the operations of the Line itself is limited due to tight security regulations, it is known that a series of huge radar installations are in operation on a round-the-clock basis. These massive radars continually search the skies to detect airborne objects heading toward the Line. Utilizing a lateral station-to-station network, an unbroken beam is formed stretching across the entire North American continent.

The instant an aircraft crosses the beam it is detected by the radars and its presence and location recorded on the screen. Detailed information about the airborne object is collected by the FEC engineers and evaluated by Air Force personnel. Essential information is then communicated to the North America Air Defense Command with headquarters at Colorado Springs, Colorado. At that stage NORAD could, if necessary, send fighters aloft from fields in the United States or Canada to intercept any enemy attack.

Utilizing hundreds of miles of plastic insulated wire in its complex operations, the DEW Line equipment has been designed to perform without interruption under the most extreme arctic temperatures and high-velocity winds — providing one of the most important links in an invaluable defense network.

World Mark Set by American Electric Capacity

The Clinch River Plant of the American Electric Power Company at Carbo, Virginia, recently became the first electric power company in the world to have generating capacity surpassing 5,000,000 kilowatts.

This new peak in generating capacity was reached when Unit 1 of the Carbo, Virginia, installation began operations, increasing the system's over-all power capacity to 5,113,000 kilowatts.

Present estimates call for the huge electric utility plan to increase this top figure by an additional 225,000 kilowatts within the next few weeks.

The final cost of the completed 450,000 kilowatt Clinch River Plant is figured at $60 million. At the present time there are only ten states in the country producing a total generating capacity beyond that of the American Electric Power network.

Construction of the Clinch River Plant was begun in 1956. Owned and operated by the Appalachian Power Company, the Carbo installation is one of six operating units in a grid extending from southwestern Michigan to western Virginia.

GE to Figure Importantly on International Scene

A group of Italian electric utilities companies have contracted with General Electric to build an atomic power station near Naples, Italy. The plant, which will start operations in early 1963, will be partially financed by the International Bank for Reconstruction and Development (World Bank of the United Nations).

General Electric was selected to construct the plant by the Societa Electronucleare Nazionale, a group of Italian utilities, after a team of seven international experts acting for the World Bank and the Italian government evaluated nine separate proposals for power stations submitted by British, French and U.S. concerns.

In another international development, announced by G.E., it was revealed that the company has been awarded a contract to construct 115 diesel electric locomotives to be used by the South African Railway Administration of Johannesburg. The exact sum of the contract was not released; however, it has been reported as totaling approximately $28 million.

Monsanto

MONSANTO CHEMICAL COMPANY

PLASTICS DIVISION — SPRINGFIELD, MASSACHUSETTS

Metal Spray Plant. The prime reason for this plant in this particular works is for aluminising of annealing bells. This gives considerably longer furnace life. The Plant is extremely useful, however, for reclaiming of worn parts, building up shafts, etc.

★ ★ ★

Welding. A welder is allocated to each maintenance zone.

★ ★ ★

Rope Inspection & Splicers. Two splicers look after the inspection and replacement of all crane ropes.

★ ★ ★

Pattern Shop. Two pattern makers look after the repairs and modifications to all patterns for spare parts. In addition they are involved in patterns for new plant.

★ ★ ★

Building. The maintenance of buildings is not the prime concern of this paper; it is however extremely important for good plant conditions.

★ ★ ★

Rain is the main enemy in a wire works as it can so easily spoil wire and wire products, hence roofs and drains must be kept in good condition. With the corrosive conditions prevalent in a wire works, this is not easy. Robertson's Protected Metal has been generally adopted for roofing and has generally proved very satisfactory. Frequent attention to gutters, drainspouts and drains is the answer, but in a works with a large acreage of roof this is easier said than done.

★ ★ ★

Painting is another important aspect of maintenance and a considerable annual expenditure is warranted, particularly for plant and steelwork.

★ ★ ★

The majority of chemical plant maintenance is the concern of the building department. As an example, one chemical plumber is almost entirely employed on the electrogalvanising process—in addition joiners and bricksetters are in constant demand for repair to acid cisterns, water boshes, sumps, etc.

It is difficult to plan building maintenance with the exception of painting, which can be preplanned to a programme.

Some Particular Aspects of Maintenance

(a) Corrosion. Cleaning houses and galvanising shops are the principal sources of trouble. No paint has yet been found that will combat acid fume corrosion satisfactorily.

★ ★ ★

It has been found to date that the rubber covering of mild steel is a good solution. This is a simple job but it is advisable to have a tradesman specifically trained for this work. This also applies to pipe work where an additional wrapping with Denso or some such product protects the exterior.

★ ★ ★

Rigid plastics are beginning to have more and more application, they are at the moment, however, expensive and best incorporated into plant at the design stage.

★ ★ ★

The complete answer is the elimination of fume and to this end much emphasis is being placed on fume extraction. This however entails a considerable amount of plant. Time and the high cost has up to date held this in check.

★ ★ ★

With the Clean Air Bill, however, this is a must and it is hoped largely to eliminate fume both inside and out within five years.

★ ★ ★

(b) Lubrication. As a wire-drawing machine is basically a motor, a gearbox and block—there is virtually one gearbox per block and clean oil is a major factor in the life of gearboxes. Great trouble has been experienced with oil seals on wet sump boxes and to combat this, Dry Sump lubrication has been introduced in a number of mills.

★ ★ ★

In this system, lubrication oil is pumped continuously through all gearboxes, lubricating bearings, worm wheels and worms individually and drained back to a sump where it is cooled and filtered. A switch on each machine stops the machine if the oil supply fails.

★ ★ ★

It would not be unreasonable to say that this system prolongs gearbox life by 50%. In addition there is a very considerable saving of oil.

★ ★ ★

(c) Electrical Materials. There have been great advances in covering cables in the last few years, two examples of which being:

(1) P.V.C. Armoured Cable, this resists acid attack and mechanical damage to a remarkable degree. It is also easy and cheap to install obviating the old fashioned conduit. This is largely used for L.T. distribution.

(2) Aluminum covered cable has the same advantages and is largely used for lighting and machinery electrification, its oil resisting properties being particularly advantageous.

★ ★ ★

(d) Tungsten Carbide. Wherever possible this material is introduced to combat wear. Running wire will wear through almost any material, hence tungsten carbide is largely used for guide bushes, wear strips, etc.

★ ★ ★

A particularly successful use has been on wire flattening machinery where a ring is inserted in the roll.

Services

Electricity, gas, water and steam —all these items are involved in the preceding section on Maintenance, but as the consumption of all of them is considerable, it is worthwhile examining each in slightly more detail.

★ ★ ★

Electricity. With a load of about 9 megawatts, this is the key to the whole works and is of course a very large item in the cost of the product.

★ ★ ★

All H.T. and L.T. gear is regularly inspected to a programme and out of date gear replaced when required.

(*Please turn to page* 1519)

Rates of Steel Rusting in the United States

by

Rust-Oleum Corporation
Evanston, Illinois

This interesting study, resulting from a quarter century of research has been prepared by a manufacturer of rust-preventing coatings.

The comparative rates at which rust proceeds in different parts of the country, have been exactly established for the first time for all United States cities over 10,000 population.

★ ★ ★

It takes three years, the fastest rate in the country, for rust to corrode a standard, uncoated steel test panel, the size of an auto license plate, in four different cities —Buffalo and Rochester, N. Y.; Erie, Pa.; and Miami, Fla. Slowest rust rate, more than 15 years, is in Tucson, Ariz.; Roswell and Santa Fe, N. M In all the nation's major industrial centers the rust rate is under four years.

★ ★ ★

This was disclosed in the first Rust Index of the United States, published recently by the company issuing this report. The Index, the result of a 25-year research program, lists the 523 cities of the country with a population of more than 10,000 and the comparative rust rate for each city. Variations in rate result from the different amounts of rainfall, wind, corrosive gases, sunlight, and salt water present in each locality.

★ ★ ★

The rust rate is three years, one month in Pittsburgh; three years, two months in Los Angeles; three years, three months in Cleveland; three years, five months in Chicago; three years, six months in New York City; three years, eight months in Philadelphia and Detroit; three years, nine months in San Francisco; and three years, 10 months in Boston and St. Louis.

★ ★ ★

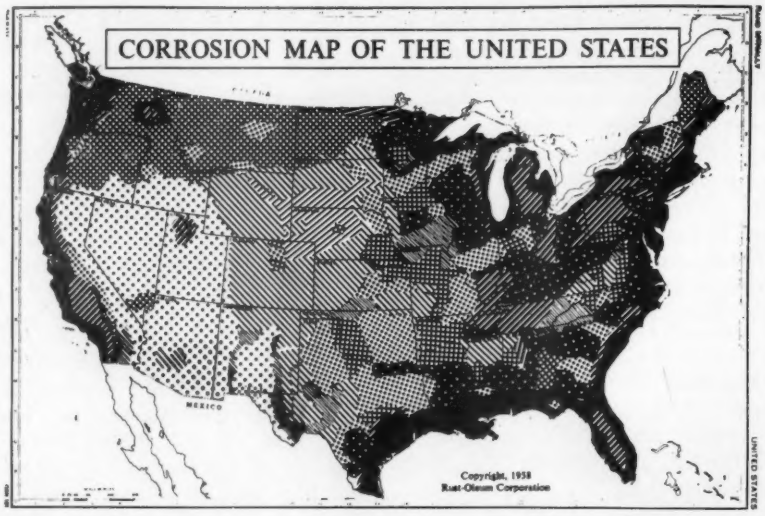
It is estimated that the nation's rust bill is currently about $7½ billion per year, an increase of $2 billion over the annual toll 10 years ago.

★ ★ ★

The index was compiled in a mamoth research program, in which dated and uncoated steel panels were left exposed at industrial sites throughout the country. The panels were of 28 gauge, low carbon, cold-roll sheet steel. Thousands of panels were dated and left exposed by Rust-Oleum representatives during the past quarter of a century. Periodic examination of the panels provided the data for the Rust Index. The criterion for the Index was the time it took for the uncoated steel panel to rust to a severe degree.

★ ★ ★

Of the 523 cities listed, 221, or 42 per cent, were indexed as Class I, meaning that uncoated test panels there rusted in less than four years. Class I rust cities include every major industrial area and most of the nation's secondary industrial centers. In Class II, where test panels rusted in four to five years, are 95 cities. The 316 cities in Classes I and II comprise 60 per cent of the nation's cities with population over 10,000.



Legend

The number of years and months required to corrode an uncoated 28-gauge steel test panel to a severe degree

YEARS AND MONTHS	COLOR CODE	YEARS AND MONTHS	COLOR CODE	YEARS AND MONTHS	COLOR CODE
3.00 – 3.11		6.00 – 6.11		9.00 – 9.11	
4.00 – 4.11		7.00 – 7.11		10.00 – 14.11	
5.00 – 5.11		8.00 – 8.11		15.00 +	

Map above shows the rates at which rust proceeds in different parts of the country. Published in a Rust Index of the United States, the data was compiled in a 25-year research program. Thousands of dated and uncoated test panels of 28-gauge steel were left exposed at industrial sites throughout the country to establish the rate of rust in each locality. Every city with a population of more than 10,000 is included in the Rust Index.

Wire Pickling

by Andreas Bürger

This article appeared in a recent issue of Draht-Welt and was translated for us by Jerome W. Howe, Worcester, Mass., with the permission of the publisher. It describes German pickling practice and notes differences between it and British methods.

About 200 years ago a technical encyclopedia began to appear, published in Berlin, in which the pickling of wire was described with extraordinary accuracy for those times. The authors go back into the past of wire pickling and conclude that the pickling of wire dates back to the very earliest pickling process. Even in the 16th Century it was recognized that wire rod is better when pickled.

★ ★ ★

There was continual search for improved processes in course of which, some went astray and produced worse rather than better results. But it is interesting to note in this encyclopedia, "If copper and brass wire are drawn for the pin or needle maker, it must go through the fire more often in order to be made malleable. The fire causes a crust to form on the wire, which must be removed. For this the wire is sent to the dyers, who lay the wire in the dye water that they have colored with the so-called Saxon colors, like Celadon green, etc., and which is composed of water, sulphuric acid, alum and tartaric acid. The wire is allowed to remain in this bath for some time, and then is thrown down forcibly to the ground three or four times, so that the crust falls away. Then the wire is sent bright to the producer." The annealing was done in the reverbatory furnace.

★ ★ ★

Here we have the modern process of pickling described in its fundamentals. By hot rolling a very hard, non-malleable layer of scale is formed. This must be removed or in its passage through the die, the latter will quickly be rendered useless. Annealing also leaves a layer of mill-scale on the surface of the wire. Since the annealing process has been operated with buffer gas, this disadvantage has lessened. The elimination of the scale can be accomplished in two ways: chemical or mechanical. In both cases the pickling house stands in the foreground. The scale adhering to the wire must be removed by pickling. In the mechanical process the wire is drawn through a device so constructed that the wire is subjected to a flexing movement, which causes the brittle scale to crack off. It follows from the nature of this process that the result will be definitely influenced by the brittleness of the oxide skin. The disadvantage lies in the unavoidable tearing which results from this drawing. Also the wire should be thoroughly dry for moisture has an unfavorable effect, as well as prolonging the scale removal period. Extensive experimentation with mechanical descaling is in progress in the United States.

★ ★ ★

In France mechanical descaling has been tried out over a longer time and to a greater degree. The machines constructed have so proved themselves that no longer is there any difference in physical values between the wire rod so descaled and that which is pickled. And the cost of the operation is reduced to about half. These experiments have not changed the fact that up to now chemical pickling is still the best and most widely used method of eliminating scale.

★ ★ ★

The anticipated use of the wire and its further processing, play a considerable role in the choice of pickling acid, whether sulphuric or hydrochloric.

German and British Practice Differ

In Germany the wire makers have overwhelmingly decided in favor of sulphuric acid; in England, on the other hand, hydrochloric is favored. If it is a question of subsequent metallic coating, the use of hydrochloric acid cannot be avoided. Keller holds that pickling with hydrochloric acid is absolutely imperative for galvanizing, tin-plating or lead-coating. He refers also to the higher rate of pickling. "For example, for pickling in continuous process often only 20 to 60 seconds is available for complete cleaning." In individual cases not only experience, but practice will decide in which cases hydrochloric acid best can be used. The preparation of the pickling bath does not differ from that of sulphuric acid.

★ ★ ★

The pickling procedure consists of several operations. First the scale must be eliminated and then the acid must be prevented from attacking the underlying metal. But the concurrence of both these operations cannot well be avoided. Since the material must remain in the bath until the last vestige of scale is dissolved, there is often a serious attack on the metal. The damage can be summarized as: (1) overpickling in especially unfavorable circumstances, (2) embrittlement of the wire, (3) a relatively high loss of material, and (4) an excessively high use of acid. In the given circumstances there is a whole range of sources of mistakes, which would affect the further working of the wire.

Inhibitors are Necessary

To avoid these disadvantages, it has become the practice to add a small quantity of inhibitor to the pickling bath. The inhibitor thus

(*Please turn to page* 1513)

REA Approves Electroplated Copper Conductors

The Rural Electrification Administration has officially published its approval of copper-electroplated steel conductor for use by telephone systems of REA borrowers. This is the first time that an electroplated copper-covered wire has been included in the REA listings of copper-covered steel conductors, according to **R. W. Elder,** manager of Specialty Sales, **National Standard Co.,** manufacturer of Copperply copper-plated wire.

★ ★ ★

The approval, given on a 2-year trial basis, is published in REA Bulletin 344-25 "List of Materials Acceptable For Use On Telephone Systems of REA Borrowers." Four sizes are listed:

a) 0.080 inch (dia) in 40% high-strength and 30% extra-high-strength

b) 0.102 inch (dia) in 30% extra-high-strength

c) 0.104 inch (dia) in 40% high strength, 40% extra-high-strength, and 30% high-strength

d) 0.128 inch (dia) in 40% high-strength and 30% extra-high-strength

★ ★ ★

More than two million pounds of "Copperply" wire have been installed to date by telephone companies throughout the United States.

ASTM Actions on Standards of Interest to Wire Men

The Administrative Committee on Standards is empowered to pass on proposed new tentatives and revisions of existing tentatives, and tentative revisions of standards offered between Annual Meetings of the Society. On the dates indicated below the Standards Committee took these actions:

Tentative Specification for Nickel Rod and Bar (B 160-49 T) (Accepted July 25, 1958)

Tentative Specification for Nickel-Copper Alloy Rod and Bar (B 164-49 T) (Accepted July 25, 1958)

Tentative Specification for Nickel-Chromium-Iron Alloy Rod and Bar (B 166-49 T) (Accepted July 25, 1958)

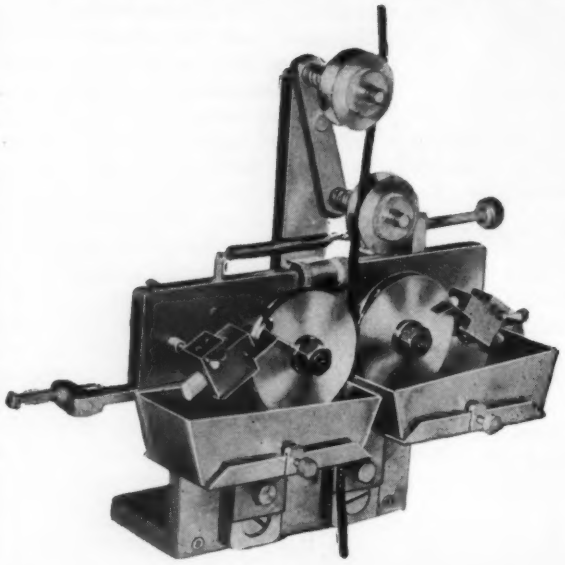
Tentative Specification for Nickel-Molybdenum Alloy Rod (B 335-58 T) (Accepted July 25, 1958)

Tentative Specification for Nickel - Molybdenum - Chromium Alloy Rod (B 336-58 T) (Accepted July 25, 1958)

New Tentatives. — Specification B 335 covers corrosion-resistant nickel-molybdenum rod, and Specification B 336 covers corrosion- and heat-resistant nickel-molybdenum-chromium alloy under two conditions: Hot-Finished, Annealed, and Descaled, 5/16 to ¾ in., excl., in diameter, and Hot-Finished, Annealed, and Ground or Turned, ¾ to 3½ in., incl., in diameter.

Standard Specification for Black Bias-Cut Varnished Cloth and Varnished Cloth Tape Used for Electrical Insulation (D 373-55) (Accepted July 14, 1958) Revision and Reversion to Tentative.—The spec-

MARKING WHEELS and MACHINES for ELECTRIC WIRE



Gillies Engraved Concave and flat marking wheels are widely used printing the I.P.C.E.A. color code, numerical, semi-spiral striped, dating, or manufacturer's identification, etc. on insulated wire, tubing or hose.

Machines print on ONE or BOTH SIDES in large legible letters. Wheels are adaptable to any machine—or we will supply the machines.

Wheels, shafts, ink pans and all accessories are readily removable for quick and easy cleaning.

Wheels are made of TOOL STEEL, HARDENED to Rockwell test 61-64 and HARD CHROME PLATED.

Send for samples of wire and prices on wheels and equipment.

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ification has been revised generally in order to correct numerous shortcomings.

Cuyahoga Works Breaks Rod Records

Responding to the increased order demands of steel rod customers, American Steel & Wire's #1 rod mill of the Cuyahoga Works here has smashed all known rod mill production records during the month of October.

★ ★ ★

Unleasing a torrent of steel rod, the mill chalked up the record high monthly tonnage total of 39,511 tons for an average of 501 tons per eight-hour turn. In all probability this is some 9,000 tons more than any rod mill in the world has ever produced during a single month. Reduced to 3/8" rod, it would stretch over 39,000 miles.

★ ★ ★

Steel rod users, who depleted their inventories during the slow business period earlier this year, demanded and received over 53 different sizes — ranging from 7/32" to 1-1/8" in diameter — of steel rods from this mill.

★ ★ ★

The production of such a large number of sizes makes the new record particularly outstanding. The different sizes necessitated over 70 individual stops of from 15 to 60 minutes for the changing of passes in the rolls, or replacing the rolls.

New D.C. Heat Exchanger Motor

The Louis Allis Co. recently announced a new D.C. Heat Exchanger motor designed to provide a wide adjustable speed range. The motor is also intended for constant speed applications and is available in ratings from 25 to 300 HP.

★ ★ ★

The motor is constructed in an explosion-proof enclosure (Class I, Group D underwriters Label) for hazardous installations and with standard enclosed construction for protection against abrasive airborne particles, dirt, coolants,

REELS FOR WIRE?

WIRE APCO MOSSBERG!

When you need steel reels, spools or bobbins fast, a wire to Apco Mossberg can save you hours of time and trouble.

Modern, high speed production facilities and a thorough knowledge of wire and wire rope handling methods enable Apco Mossberg Engineers to handle your packaging problems pronto! Their ability to produce custom designed units quickly and economically is one reason why more and more major wire manufacturers "ask for Apco" first. Why not put their experience to work for you?

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World Trade Center
Ferry Building
San Francisco 11, California

Canadian Representative:
Hugh P. Williams & Co.
47 Colburne Street, West
Toronto, Ontario, Canada

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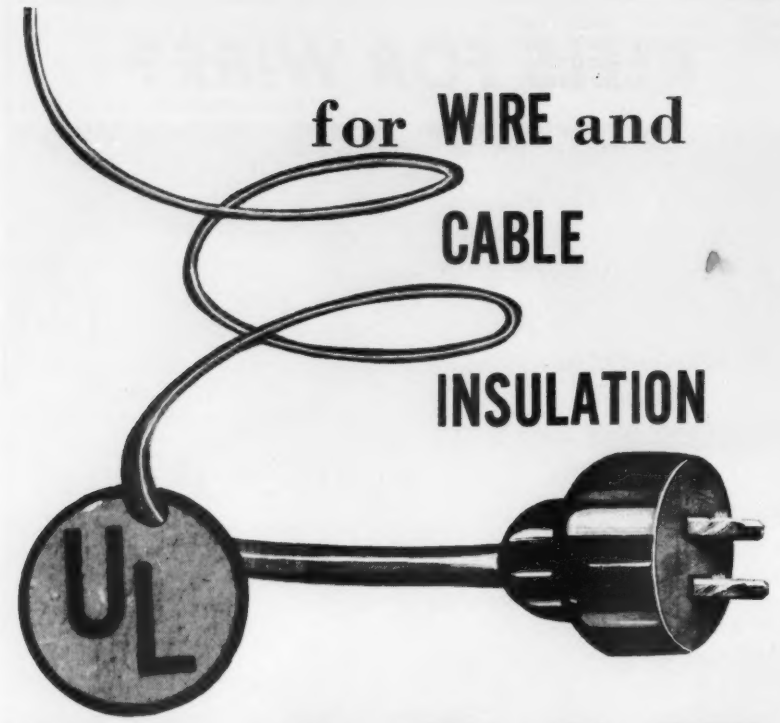
LAMB STREET, ATTLEBORO, MASSACHUSETTS



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PVC RESIN—Blacar #250—UL-approved for complete interchangeability in recognized compounds. High molecular weight—low gel count—excellent dry blending and extrusion characteristics.

Intermediate and low molecular weight resin also available.

PVC COMPOUNDS—In natural, white or black—dry blend or diced:

Blacar #2800—UL-approved for type T and TW wire—oil at 60°C—80°C appliance wire.

Blacar #2700—UL-approved, primary insulation, for type T, TW, TF, TFF wire—oil at 60°C—wide range of low-tension applications.

Blacar #2600—UL-approved for type E, TF, and TFF wire and cable insulation.

Specialists in wire covering—Cary can modify existing formulations or custom-formulate to the most exacting requirements.

Technical assistance, data, or working samples on request.

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- Gilsonite Compounds
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Canadian Representative: Lewis Specialties, Ltd., 18 Westminster North, Montreal 28, Que.

moisture, oil vapors and other severe atmospheric conditions, indoors or outdoors.

★ ★ ★

The range of adjustable speed of this motor extends from 5% of base motor speed by armature control (constant torque) to 400% of base speed by field control (constant horsepower). A major factor in broadening this adjustable speed range and in reducing motor size to a minimum is the use of an integrally mounted A.C. fan motor to supply a constant flow of cooling air regardless of the speed of the D.C. motor.

★ ★ ★

Heat exchanger tubes of heavy-section, high tensile strength aluminum alloy are distributed around the periphery of the field ring for effective air-to-air heat removal. Heavy rolled steel field ring and cast steel bearing brackets are also used to equip the motor for rigorous industrial service. The motor can be mounted floor horizontal, wall or ceiling horizontal or vertical with the shaft up or down.

★ ★ ★

For complete information, request Bulletin #3000 from The Louis Allis Co., Dept. P, 427 E. Stewart St., Milwaukee 1, Wis.

New Motorized Gear Drive Bulletin

The Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis., recently published a four page bulletin, No. 2350, on its new Line-A-Spede motorized gear drives.

★ ★ ★

These drives are gear reducers powered by standard NEMA frame motors mounted on a shelf attached to the reducer. The bulletin illustrates how the Line-A-Spede facilitates standardization of motors to reduce inventory and permits rapid motor changes—vital in continuous operation applications such as conveyors, process equipment, agitators, etc.

★ ★ ★

Construction features are illustrated in a cutaway, and engineer-

ing specifications and dimensions are given. The Line-A-Spede utilizes double, triple and quadruple reduction units for ratios up to 1487 to 1 with motor ratings of 1 to 75 HP. The drives are powered by motors of all types and enclosures, and can be mounted in any position.

Indian Firm Opens New Administration Building

V. G. G. Nayar, General Manager of **The Aluminium Industries Ltd.,** Kundara, India, has announced that on September 27, 1958, the company's new administration quarters were formally opened The inauguration address was given by **Dr. B. Ramakrishna Rao,** Governor of Kerala State.

New Miniature Cold Header

The Robert E. Morris Company, 5004 Farmington Ave., West Hartford, Conn., has introduced the new Omega "OO" Cold-Heading machine, designed primarily for miniature parts.

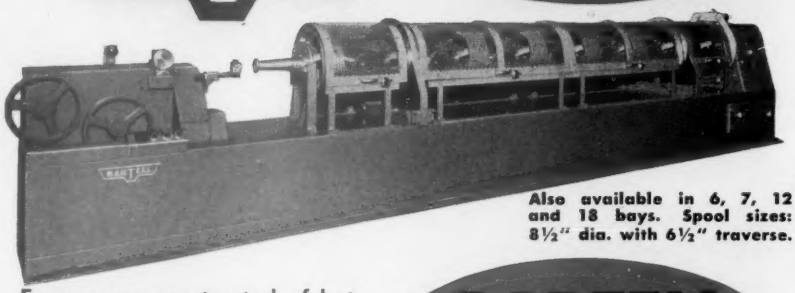
Omega "OO" Cold Header.

Electrical contacts, rivets, pins and similar parts as small as .012" diameter x .016" long can be produced on this machine. The "OO" is a standard solid die, double stroke heading machine, that will cut to length, head and form between 80 and 120 pieces per minute, to extremely close tolerances. The maximum wire diameter accommodated is .070" with most alloys and up to .120" with soft aluminum. Part lengths may range from .016" to .400".

* * *

Hollowing of rivets as well as heading may be performed in one

BARTELL FOR THE BEST



Also available in 6, 7, 12 and 18 bays. Spool sizes: 8½" dia. with 6½" traverse.

BARTELL SEVEN BAY HIGH SPEED STRANDER MODEL 7B-58-15

Frames are constructed of hot rolled shapes and plates to form a rigid box structure. Barrel is extruded 6062T-6 aluminum — Smooth starts through slip clutch driven by 7½ H.P. motor — Operators control station at front of machine — Main power control center at drive end — Electronically controlled automatic stop energizes solenoid operated brakes in event of wire breakage — Spool cradles and associated parts are completely interchangeable from one machine to another — Tungsten carbide wire guides throughout — Lay from ¼ in. to 5 in. long.

• CATERPILLAR CAPSTANS • SINGLE AND MULTIPLE HEAD RE-SPOOLERS • TAKE-UP & PAY-OFF STANDS FOR PLATING EQUIPMENT • WIRE STRANDERS

BARTELL TAKE-UP

This Take-Up is belt-driven, the drive originating from a slip clutch located outside the capstan box. Electrically operated traverse adjustable from zero to maximum reel width. Accommodates reels up to 30" dia. Speed selector sheave adjusts lay on reel to suit diameter of finished strand.

WE ALSO DESIGN AND BUILD SPECIAL EQUIPMENT TO MEET SPECIFIED REQUIREMENTS

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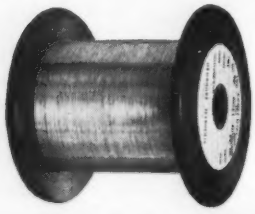
How Lestershire Bobbins save money for Wire Manufacturer and its customers



Because they take rough handling in shipment, are re-usable and weigh far less than metal bobbins, Lestershire Wire Bobbins cut costs and losses for both a magnetic wire manufacturer and its customers.

Withstand rough treatment. Extra dense Vulcanized Fibre bobbin heads prevent damage to wire or bobbins in transit. Where brittle, metal-bound wood heads chip easily, shock-absorbing Vulcanized Fibre heads resist chipping and denting. In fact, Vulcanized Fibre has *self-healing* properties; bumps "iron themselves out" to the original, smooth, hard finish.

Last indefinitely. Lestershire patented anchor screw construction gives extra ruggedness to the head-barrel joint. Added strength in materials and construction means that Lestershire Wire Bobbins wear indefinitely. You can use them over and over again—and save the cost of frequent replacements.

Save shipping charges. Vulcanized Fibre weighs less than half as much as aluminum. The light weight of Lestershire Bobbins means big savings in shipping.

Send for free details. For full information on the Lestershire Line of Wire Bobbins, get our 12-page comprehensive Bobbin Manual. Write for your free copy direct to: Dept. GG—12.

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operation. The depth of the hole, depending on the material being used, is equal to 3 times the wire diameter in aluminum and 1½ times in copper and brass.

★ ★ ★

A minimum of maintenance and service is required, with one-shot lubrication of the entire machine provided. One set of dies is supplied with each machine to make one specific part of customer's choice. Core reel, straightening rolls, feed rolls, built-in Vee belt motor drive and guards are standard equipment.

★ ★ ★

For further information and literature, please write the company at the address above.

ASTM Actions on Standards

Those recent actions on standards that are of interest to wire men are listed below.

★ ★ ★

Tentative Specification for High Strength Billet-Steel Bars for Concrete Reinforcement (A 431 — 58 T)

★ ★ ★

This specification covers deformed bars, rolled from new billet steel. The material is of a special high-strength grade and is intended for use in concrete structures designed for steel reinforcement with a high yield point.

★ ★ ★

Tentative Specification for Welded Steel Wire Fabric for Concrete Reinforcement (A 185 — 56 T)

★ ★ ★

Revised to include galvanized fabric, and the procedures for tension tests and weld shear tests have been more fully described.

★ ★ ★

Standard Specification for Cold-Drawn Steel Wire for Concrete Reinforcement (A 82 — 34)

★ ★ ★

Revised to include the basic oxygen process of steelmaking and to cover galvanized wire.

★ ★ ★

Standard Specifications for Sieves for Testing Purposes (Wire Cloth Sieves, Round-Hole and Square-Hole Screens or Sieves) (E 11 — 39)

★ ★ ★

The present nominal permissible range for wire diameters for each sieve has been changed to a single recommended nominal wire diameter with a permissible deviation expressed in percentage for range of sieve opening.

★ ★ ★

Tentative Specification for Rectangular Copper Wire for General Purposes (B 272 — 52 T)

★ ★ ★

This specification has been made complete within itself rather than referring for certain requirements to the Specifications for General Requirements for Wrought Copper and Copper-Alloy Wire (B 250 — 55 T). The title has been changed to read "Specification for Flat Copper Products with Finished (Rolled or Drawn) Edges (Flat Wire and Strip)."

★ ★ ★

Tentative Specification for General Requirements for Wrought Copper and Copper-Alloy Wire (B 250 — 58 T)

★ ★ ★

There have been removed certain requirements relating to Specification B 272 which are no longer needed in view of the revision of B 272 mentioned above. The title has been changed to read "General Requirements for Wrought Copper-Alloy Wire."

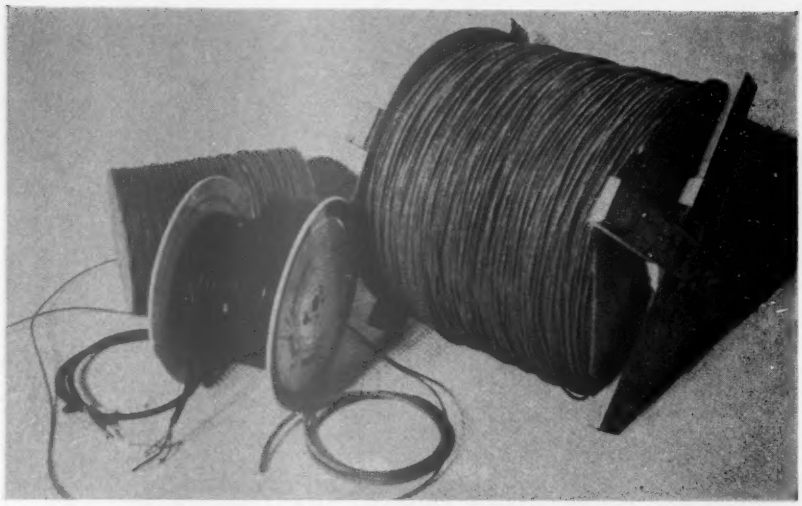
★ ★ ★

Tentative Method of Test for Diameter by Weighing of Fine Wire Used in Electronic Devices and Lamps (F 205 — 56 T)

★ ★ ★

Changes in the density values in Table I were made to align this specification with the newly adopted densities in the Specification for Round Wire for Use as Grid Lateral Winding Wire in Electronic Tube Grids (F 290 — 57 T).

★ ★ ★



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TEXTILENE GLASCOR*

Soft, dry fillers for portable and flexible cords, Textilene Glascor and Twi-Port have wide acceptance. Fiberglas-centered Glascor is exceptionally strong without added bulk or sacrifice of pliability. It goes into S, SJ, and SV cords with 18, 16, and 14 gauge conductors — Twi-Port into S and SJ cords with 12 gauge and larger conductors. Successful applications include control, appliance, and power cables; telephone drop wire; communications and coaxial cables.

Twitchell's superior Textilene line also includes: Fungus-resistant filler — *Twi-Tar*. Used for buried communications cable, expanded ACSR cable, and in other applications.

Moisture-resistant fillers—*Twi-Flex* and *Twi-Wax*. Used for non-metallic sheathed cable, maritime shipboard cable, varnished cambric cable.

*Patent No. 2832190

For Every Wire and Cable Application
Twitchell's TEXTILENE Fillers Fill The Bill

Quality-controlled materials that are dependably uniform . . . in standard forms, or customized to special needs.

Initial low cost with savings added by production efficiency . . . flexible, ready-to-use fillers that fit all equipment, handle and form easily, always maintain desired shape.

Assured supply from a reliable domestic source . . . always available in economical and convenient packaging.

Proved performance as components of cables and wires that meet government specifications . . . stability shown by trouble-free installations in continuous service 20 years and longer.

FREE — SAMPLE SPOOLS of any type of Textilene filler to demonstrate the superiority of Twitchell materials in your operation—also technical counsel without cost or obligation. Just tell Twitchell your end-use requirements. *Write, wire, or phone today:*

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9BA78

Tentative Method of Test for Sag of Tungsten Wire (F 269—52 T)

★ ★ ★

The size ranges of wire that may be tested under this specification have been increased, and the exposed test lengths and weights are included for these larger diameter sizes. The diameter of bend for the hairpin has been changed.

New Copper Alloy Rod Has Unique Properties

Scovill Manufacturing Company, Waterbury, Conn., has recently made available, in rod form only, an entirely new alloy designated OFHC+Sulphur Copper (Scovill Alloy No. 1032).

★ ★ ★

It is believed that this new material will be especially interesting to fabricators making parts and components for the electrical, electronic, aeronautical and many industrial fields where excellent machinability must be matched by very superior thermal and electrical properties. In these important respects, new Sulphur Copper Rod has a machinability rating of 90 (Free Cutting-Brass = 100); its electrical and thermal conductivity are approximately 96% of that of OFHC or ETP copper as compared to 90% for Tellurium copper.

★ ★ ★

The new alloy also has excellent hot-working characteristics for forging and pressing, and shows cold working characteristics comparable to pure copper. It is more ductile than Tellurium copper. Its general corrosion resistance is comparable to pure copper and it has proved especially satisfactory in resistance to "stress corrosion cracking."

★ ★ ★

Technical bulletin on OFHC + Sulphur Copper (Scovill Alloy No. 1032) available on request to Scovill Manufacturing Company, Mills Division, Waterbury 20, Conn.

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Aluminum Magnet Wire Offered by Alcoa

Aluminum magnet wire has become available for the first time at a price that reflects the lower cost of aluminum in comparison with copper.

* * *

The development was announced by **Aluminum Company of America,** which has placed on the market a new line of aluminum magnet wires. Potential use of the new wire is in such devices as motors, solenoids, and generators.

* * *

Alcoa has made an arrangement whereby **Rea Magnet Wire Company, Inc.,** Fort Wayne and Lafayette, Ind., will manufacture the aluminum magnet wire as an Alcoa product, selling it as an agent of Alcoa. Rea is a leading independent producer of magnet wire, and has pioneered several innovations which are today commonplace in the magnet wire industry.

* * *

The wire will be offered initially in AWG sizes #12 through #24, and will be available on spools or in pails. The aluminum wire will be manufactured chiefly with three types of insulation: Formvar, Nyform, and Isonel.

Bulletin on Woven Wire Belts

The Colorado Fuel and Iron Corporation has initiated publication of a quarterly bulletin containing items of news and technical interest on the company's Wissco woven wire processing belts.

* * *

Called "The Wisscollator," the four-page, illustrated folder includes the following information:

1. **A case study describing how Wissco belts helped solve an unusual conveyor problem involving processing of fiber-glass mats first through a hot alkali solution and then through a hot oven.**
2. **A section on facts about balanced spiral weave belt.**
3. **A study of factors to be considered in the selection of metal conveyor belts.**
4. **Suggestions for increasing both operating efficiency and life expectancy of metal conveyor belts.**
5. **A section devoted to typical uses**

...Why? Because NYECO REELS:

- Are lighter—they lower freight costs.
- Outlast 12 wooden reels—require little or no maintenance.
- Are rugged, weatherproof and splinter proof.
- Warp-proof construction protects costly cable from handling damage.
- Protect your reputation—They insure your cable's safe arrival.

* These leading mills are just a few of the many that use NYECO Steel Reels: ANACONDA, GENERAL CABLE, OKONITE, PHELPS DODGE, ROEBLING, WESTERN ELECTRIC

- *ANY QUANTITY*
- *ANY SIZE*
- *ANY LOAD*
- *FLANGE DIAMETER From 36" UP*

Write • Phone • Wire

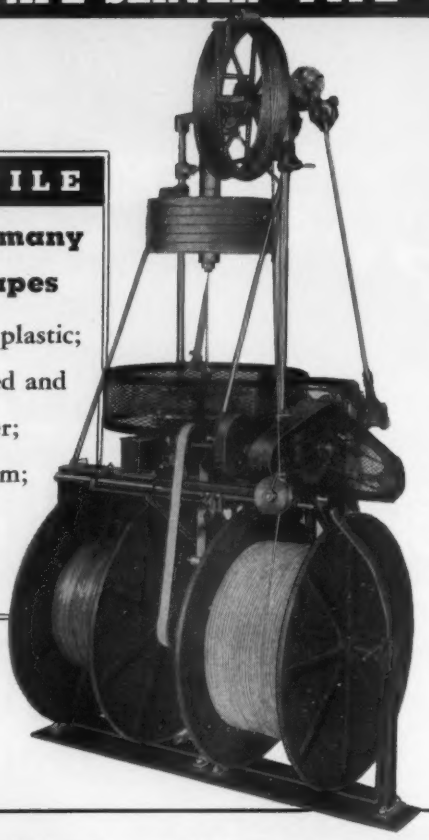
NYECO Specialists to the Wire Industries for Over 45 Years

NEW YORK ENGINEERING COMPANY

75 West Street, New York 6, N. Y.

TELEPHONE: WHitehall 4-5380 CABLE: NYECO, N. Y. PLANTS: YONKERS, N. Y.

NEW WARDWELLIAN
TAPE SERVER - TYPE "B"



VERSATILE

for serving many kinds of tapes

Teflon; vinyl; plastic; cambric; treated and untreated paper; glass; aluminum; brass and copper.

- Equipped with adjustable traverse, supply and windup stands, windup driving mechanism, and electric stop-motion. Capstan-release mechanism permits retracting conductor and replacing it for restarting operation after replenishing supply.
- Machine will apply tapes from ½" wide up to 1" wide on electrical conductors.
- "Reeves" variable speed unit provides for quick adjustment when change of lay is required.
- Production dependent upon width of material and angle of lay.
- Serving head speed dependent upon kind of material. Maximum speed 700 RPM.
- Driving pulley 8" diameter; 1¾" belt. Speed of pulley 330 RPM.
- Ratio serving head speed to pulley speed 2.12 to 1.
- Capstan 18" diameter, 3" face.
- Opening through serving head ⅝" diameter.
- Maximum diameter of flexible conductor ⅜".
- Supply packages 16" diameter, 1" maximum width, ½" minimum width. Size of hole in package 3".
- Supply tube holds eight reserve packages of 1" wide material.
- Maximum power requirement ¾ H.P.
- V-belt motor drive furnished upon request at additional cost.
- Reset counter for measuring product in feet furnished.
- Stands furnished to accommodate reels 30" or 36" in diameter with overall widths up to 16". Wider stands can be furnished upon request at additional cost.
- Special windup drive required for reels with drums under 12" diameter.
- Clamp lock holds windup reel arbor securely in lifter bearing.
- Machine mounted on base plate to assure proper alignment of frame and windup stand.
- Reels not furnished with machine.

Write for complete information

576

WARDWELL
BRAIDING MACHINE CO.

1212 HIGH STREET
CENTRAL FALLS
RHODE ISLAND, U. S. A.

Representatives for Europe, British Colonies and Dependencies
JAMES MACKIE & SONS, LTD., BELFAST, IRELAND

and users of Wissco belts.

★ ★ ★

Copies of "The Wisscollator" can be obtained by writing to The Colorado Fuel and Iron Corporation, Wickwire Spencer Steel Div., 575 Madison Ave., New York 22, N. Y.

Booklet on Barrel Finishing Compounds

Compounds designed for deburring, burnishing, and descaling metals in barrel operations are the subject of an eight-page booklet recently published by **Oakite Products, Inc.**, manufacturers of metal treating compounds.

★ ★ ★

A treatise on the nature and uses of barrel finishing, the booklet points up the necessity for the right combination of media, solution, speed, and loading. It tells how to preclean parts, how to select media for specific metals, shapes and sizes of parts, operations to be performed, and finishes desired. Compounds discussed include alkaline and acidic, abrasive and non-abrasive, each designed for specific operations. Emphasis is placed on the need for proper barrel technique.

★ ★ ★

Copies of the booklet are available from Oakite Products, Inc., 152A Rector Street, New York 6, New York.

Torquemeter Measures Dynamic Torques

Torque ranges covered by a new torquemeter are from 5 to 250 oz.-in. full scale. Special units for higher torques are available. These torquemeters measure dynamic torques on shafts turning between 50 and 12,000 RPM with an accuracy within 2% of full scale. Easy-to-read linear scales and simple calibration minimizes operator error. Torque readings are independent of shaft speed and direction of rotation. Simple calibration adjustment provides stability against ambient changes and internal aging effects.

★ ★ ★

Made by Metron Instrument Co.,

432 Lincoln St., Denver 3, Colo., these torquemeters are ideal for laboratory, field or shop use. Descriptive folder available upon request.

Open-Type Motors Described in New Bulletin

"Super-Seal" open-type motors suitable for many applications previously requiring enclosed designs are described in a new bulletin released by **Allis-Chalmers.**

★ ★ ★

Available in all integral horsepower frames, the motors are unaffected by moisture, dust, dirt, oils, acids, and alkalies, and have an encapsulated stator design in smaller sizes and "Silco-Flex" insulation in larger sizes, both of which result in maximum protection.

★ ★ ★

In addition to lower cost as compared to totally-enclosed, fan-cooled designs, "Super-Seal" motors have a 1.15 service factor which frequently permits using a smaller motor size. An example of how the motor saves 30 percent on a typical pump drive is given in the bulletin.

★ ★ ★

Copies of "'Super-Seal' Open-Type Motors," Bulletin 05-51B90-40, are available on request from Allis-Chalmers, Milwaukee 1, Wis.

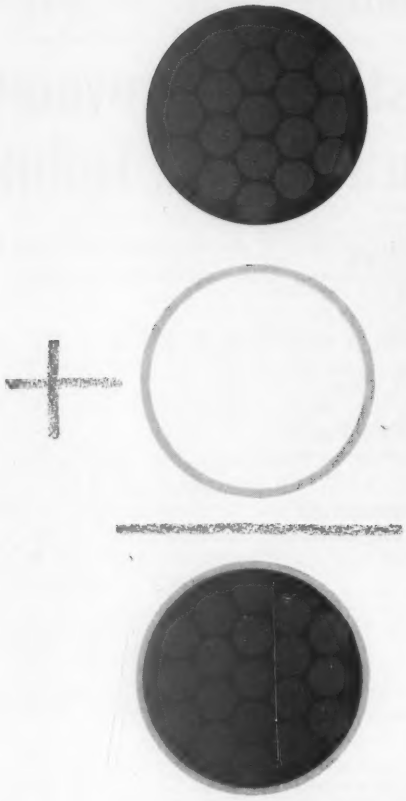
Horizontal "Weather Protected" Motor Bulletin

The Louis Allis Co., 427 E. Stewart St., Milwaukee 1, Wis., recently announced publication of a six page bulletin, No. 2550, on its new line of horizontal Weather Protected Motors available in ratings from 250 to 2000 HP.

★ ★ ★

These motors are designed for outdoor operation under extreme weather conditions, for use in such industries as chemical, petroleum, paper processing, public utility and applications in pipeline, boiler feed pump and other outdoor industrial installations.

★ ★ ★



Wire coating problem? Best solution: come to Lacquer Headquarters

Specialists in formulating and producing lacquers for the insulated wire industry, NELCO has analyzed and solved just about every conceivable application problem.

In more than 37 years, our research organization has developed countless special NELCO Lacquers. Each is designed to do a specific job, and do it supremely well.

Thus, you and your customers have the assurance that the lacquer coating is equal in quality and performance to your insulated wire and, like it, ready to meet the highest specifications.

With the NELCO data book in your file, you will have authoritative facts on a wide variety of finishes for wire and cable constructions. Write for it now, or send us information on your specific requirements.

NELCO
LACQUERS

Chemical Products Corporation
EAST PROVIDENCE, R. I.

Spark Testing Improvements Needed in the Wire Industry

. . . as expressed by authorities speaking at the Symposium on Spark Testing at the Annual Wire Association Convention, Atlantic City, N. J., October 13, 1958.

ON SAFETY:

"The first consideration in spark testing is safety. The short circuit secondary current of the spark tester should be *automatically limited to 10-milliamperes**, plus or minus about 10%, at all testing voltages. The consensus of all opinions indicates that a current of less than 15-milliamperes is perfectly safe from an operator's standpoint."

*A FEATURE OF JLE "CONTROLLED POWER"** SPARK TESTERS SINCE JANUARY, 1957!

"However, to be doubly sure, the testing voltage should be cut off not longer than one second after fault location, or after accidental operator contact, on all operations except extruding."*

*A FEATURE OF JLE "CONTROLLED POWER"** SPARK TESTERS SINCE JANUARY, 1957!

"All warning lights should be in multiple. . ."*
"All sparker access doors should be equipped with safety switches, and switches which are still energized when exposed should be on separate low-voltage circuit."*

*FEATURES OF JLE SPARK TESTERS SINCE JULY, 1956!

"Operator should not have to pull wire back into Electrode by hand after locating fault."*

*AUTOMATIC REVERSING AFTER FAULT LOCATION, A FEATURE OF JLE RE-REELER SPARK TESTERS SINCE JULY, 1956!

ON FAULT CIRCUITS:

"The sparker fault circuit should be self-adjusting to all operating conditions, requiring no setting or manipulation by the operator to adjust it to proper sensitivity. The fault location circuit should be of the maintained or trigger type, so that once tripped, it will remain tripped until reset electrically or manually. It should contain voltage limiting tubes to prevent build-up of excessive voltages at the instant of fault location to protect other equipment from voltage breakdown."*

*FEATURES OF JLE SPARK TESTERS SINCE JANUARY, 1958!

"The spark tester should have a built-in self-testing circuit so that the operator can check the operation of the fault location circuit at definite intervals, or it should have an automatic self-testing circuit which will check the fault location circuit at periodic intervals of about an hour, and which will provide a warning signal for malfunction of the fault circuit. . . ."*

*PLUG-IN RECEPTACLES FOR SPARKER CALIBRATING UNITS HAVE BEEN A FEATURE OF JLE SPARK TESTERS SINCE DECEMBER, 1957! BUILT-IN SELF-TESTING CIRCUITS ARE NOW INCORPORATED IN OUR NEW MACHINES!

QUESTIONS TO BE RESOLVED BY THE INDUSTRY:

A.C. OR D.C. SPARK TESTING? . . . HOW MUCH VOLTAGE SHOULD BE APPLIED?

Whether A.C. or D.C. voltage, or possibly high-frequency, should be used, as well as the amount of voltage to be applied to any particular insulation, are questions receiving considerable attention at the present time.

The answers cannot be given until the Industry decides first whether it is satisfied with an instantaneous application of voltage as supplied by an extremely short electrode, or whether the voltage should be applied for a definite length of time as is called for in present Standards. If the latter is decided upon, then our recommendation would be to use A.C. spark testers for all wire speeds up to 2,000 fpm., and D.C. spark testers for speeds over 2,000 fpm., the latter to eliminate the use of electrode units over 5 feet in length.

The amount of voltage which should be applied to any given insulation will depend upon a decision by the Industry as to whether it wishes to find only voids which extend completely through the insulation, or whether it desires to pick up and locate voids which penetrate the insulation only part way. Our recommendation would be to locate faults or voids which extend ¾ or more of the distance through the insulation wall.

WHATEVER THE INDUSTRY DECIDES, THE JAMES L. ENTWISTLE COMPANY HAS THE EQUIPMENT TO DO THE JOB . . . COMPLETELY DESIGNED, ENGINEERED AND READY . . . RIGHT NOW!

MORAL: Spark testing needs are constantly being anticipated and solutions pioneered at the James L. Entwistle Company. We can solve your problems, too. . . . Just ask for consultation . . . there is no obligation.

James L. Entwistle Co.

SPARKING THE WIRE INDUSTRY SINCE 1918 JLE

100 GLEN ROAD, CRANSTON 10, R. I., U.S.A.
MAILING ADDRESS, P.O. BOX 3674
CABLE "JALENCO" PROVIDENCE - PHONE HOPKINS 7-8411

ENGLAND: *General Engineering Co. (Radcliffe) Ltd.*
Station Works - Bury Road
Radcliffe, Lancashire, England

** PATENT APPLIED FOR

Cutaway drawings in the bulletin illustrate a motor construction that is impervious to extremely high winds, driving rain, snow, sleet and sandstorms, while utilizing surrounding air for cooling purposes. Standard and special features are described, and full motor specifications given.

200 KV High-Voltage Test Set

A new model with 200 KV rms output is available for high voltage tube testing, for cables and bushings, all dielectric materials and high voltage apparatus in general, in accordance with ASTM testing methods.

★ ★ ★

Mounted for easy mobility and fitted with large corona-free oil-filled bushings, this tank unit may be located in an interlocked test area and remotely controlled with a small control cabinet.

★ ★ ★

The set features high KVA capacity, low waveform distortion and low corona level. Multi-range meters are available for both output voltage and current. Metering is directly at high voltage output for highest accuracy regardless of transformer regulation or type of load, yet meters are at ground potential.

★ ★ ★

Standard features include all safety and convenience controls, external interlock provision, zero start interlock, overload circuit breaker, continuously adjustable output voltage with either manual or motorized output control.

★ ★ ★

Other options include a synchronous timer for timed application of high voltage for sixty seconds. Input voltage requirement is 220 volt or 440 depending on KVA capacity of test set, which is available in many sizes from 2 KVA to 100 KVA.

★ ★ ★

Write Peschel Electronics, Inc., R.F.D. 1, Towners, Patterson, N.Y., for further details.

Outstanding Personalities of the Wire Industry

Gray Retires from W. E.

Alvin N. Gray, after 36 years in the employment of the **Bell Laboratories** in New York and the **Western Electric Company's** Point Breeze Works, has announced his retirement as of October 31, 1958.

★ ★ ★

He is a native of the State of Virginia. A graduate Chemical Engineer of the University of Virginia as of 1922. His entire career has been devoted to the manufacturing problems involved in rubber and plastic insulated wire and cable and the continuous electro deposition of metals on wire. He was given the James H. McGraw Award for Electrical Men a year ago and at the time of his retirement was Assistant Superintendent, Development Engineering.

★ ★ ★

Although retiring from Western Electric, Mr. Gray does not intend to discontinue his interests in the problems which have intrigued him throughout his life and will continue working on special assignments; first, for some time in Japan, after which he intends returning to this country and to continue by arrangements to work in the same field.

Alvin N. Gray

Wickwire Spencer Appointment

The appointment of **James H. Richardson** as manager of the product development department for the **Wickwire Spencer Steel Division of The Colorado Fuel and Iron Corporation** has been announced by **H. C. Allington,** Eastern divisional vice president **in** charge of sales.

★ ★ ★

The Wickwire Product Development Department is headquartered in Buffalo, New York, and works with Colorado Fuel and Iron operations in that city as well as in Claymont, Del., and Palmer, Mass.

★ ★ ★

Among the products handled by Mr. Richardson's department are plate fabrications, woven wire products, merchant wire and per-

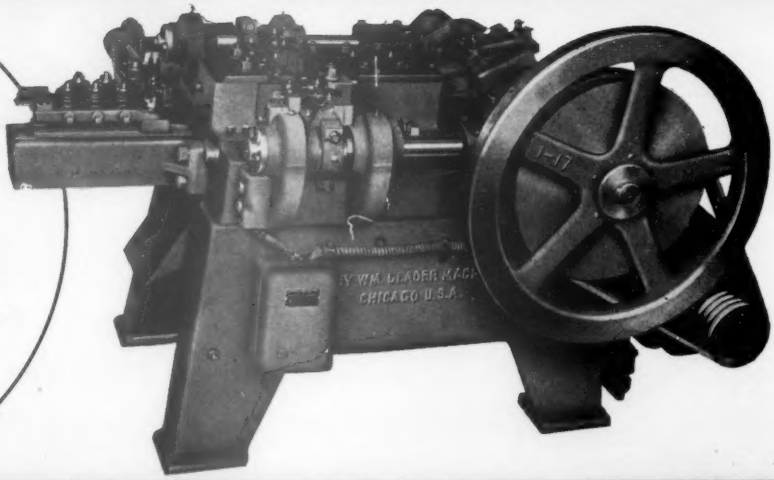
GLADER

HIGH SPEED WIRE NAIL MACHINES

HIGH TONNAGE OUTPUT—LOW MAINTENANCE COST

You can take care of increased production schedules and better product demands with these machines of established reputation.

For 55 years GLADER MACHINES have been giving HIGH QUALITY, LOW COST nail production.



Wm. Glader Machine Works

210 N. Racine Avenue
Chicago 7, Illinois

Export Dept.: 122 E. 42nd Street, New York 17, N. Y.

forated and fabricated materials.

★ ★ ★

He joined The Colorado Fuel and Iron Corporation in 1949 and worked in the wire products sales department in Denver. He is a graduate of the Alabama Polytechnic Institute.

Heads Metallurgical Development

The appointment of **Walter F. Craig, Jr.,** as Manager of Metallurgical Development of **Climax Molybdenum Company,** a division of **American Metal Climax, Inc.,** has been announced by **Reuel E. Warriner,** Vice President, Sales.

★ ★ ★

Mr. Craig, who has been associated with Climax since 1950, serves as the company's specialist in the development and improvement of molybdenum-bearing alloy steels. In his new position he will head a staff of engineers providing developmental assistance and technical services to producers, designers and fabricators of irons, steels and other metals containing molybdenum.

★ ★ ★

He received his B.S. degree from Iowa State College in 1936. Before joining Climax he was supervisor of ferrous metals research for Armour Research Foundation and had also served as a research metallurgist for United States Steel Corporation.

Retires as Vice Chairman of Sheet and Tube

The retirement of **Walter E. Watson,** vice chairman, **The Youngstown Sheet and Tube Company** has been announced. His service in the steel industry began before the turn of the century and it brought him a wide circle of friends and acquaintances throughout the industry.

★ ★ ★

He attended Shippensburg (Pa.) State Teachers College and supplemented his education with special work at the University of Pennsylvania. He joined the Youngstown Sheet and Tube Company in 1913 as assistant general manager of sales. He became general manager of sales in 1917, vice president in charge of sales in 1924, first vice-president in 1943, a director in 1944 and a member of the executive committee in 1953. Mr. Watson's election as vice chairman of the board became effective December 1, 1956.

To Head Research for Screw Concern

Samuel W. Chantler has been appointed Director of Research and Development of **The Allen Manufacturing Company** of Bloomfield, Conn., according to announcement by **Malvern J. Mather,** president of the socket screw manufacturing company.

★ ★ ★

He joined Allen after fourteen years as chief production engineer for the **Elastic Stop Nut Corporation.** During his time with ESNA, patents for the "Rollpin" and the

NOW... WITHIN 48 HOURS

- RUGGED
- ONE PIECE
- LIGHT WEIGHT
- CRUSH AND WARP RESISTANT

BOONTON "PLASTISPOOLS" CAN BE ON THEIR WAY TO YOU WITHIN 48 HOURS

A PHONE CALL OR LETTER WILL BRING SAMPLES AND PRICES FROM

BOONTON MOLDING CO.

BOONTON, NEW JERSEY TELEPHONE DEerfield 4-4400

self-locking screw were issued to Mr. Chantler, and assigned by him to the company.

★ ★ ★

Prior to that, in 1944, he was with Westinghouse in various technical, engineering and production capacities for eighteen years, and in 1942, received the "Order of Merit" conferred by the Westinghouse Board of Directors for outstanding work.

To Handle Product Planning for L. O. F.

J. Gilbert Mohr has joined **L. O. F. Glass Fibers Company** as an engineer in the product planning department, it is announced by **Hugh W. Paul,** department manager.

★ ★ ★

Associated with Allied Chemical Corporation since 1955, he was also general manager of the Process Development Company and quality control manager with the Fiber Glass division of Libbey-Owens-Ford Glass Company.

★ ★ ★

He is the inventor of several devices for manipulating glass fibers and producing improved reinforced plastic structures. He has written various articles for trade magazines on industrial developments in glass and ceramics.

Thompson Chemical Appoints

The appointment of **Allen E. Polson** to the newly created position of Director of Sales is announced by **Victor J. Baxt,** Vice President of **Thompson Chemical Company.** An established supplier of Truflex plasticizers, Thompson entered the synthetic polymer field several years ago with construction of a large modern vinyl resin facility in Hebronville, Mass. Trulon resins, produced in this plant, have already gained wide acceptance in the manufacture of film, sheeting, profiles, flooring, and military and Underwriters Laboratories specification wire and cable insulation.

★ ★ ★

A chemical engineer from the University of Minnesota with further education in patent law at Columbia University, Mr. Polson has devoted his entire business career to the plastics and synthetic polymer industries. Associated with duPont in various capacities including research and patent law, he has most recently been connected with the Goodyear Tire & Rubber Company.

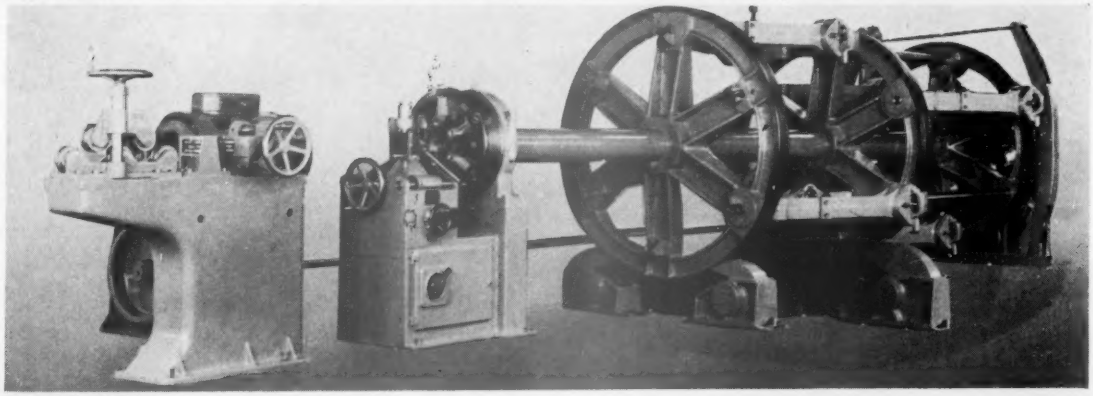
★ ★ ★

Mr. Polson will be located in the company's home offices in Pawtucket, Rhode Island.

Cleveland Tramrail Southern Manager

Don B. Hooser has been appointed Southern District Manager of the **Cleveland Tramrail Division, The Cleveland Crane & Engineering Co.,** Wickliffe, Ohio, manufacturers of overhead materials handl-

WE OFFER SUPERIOR MACHINES MEETING ALL REQUIREMENTS FOR THE MANUFACTURE OF ELECTRICAL WIRE & CABLE, WIRE ROPE ETC.

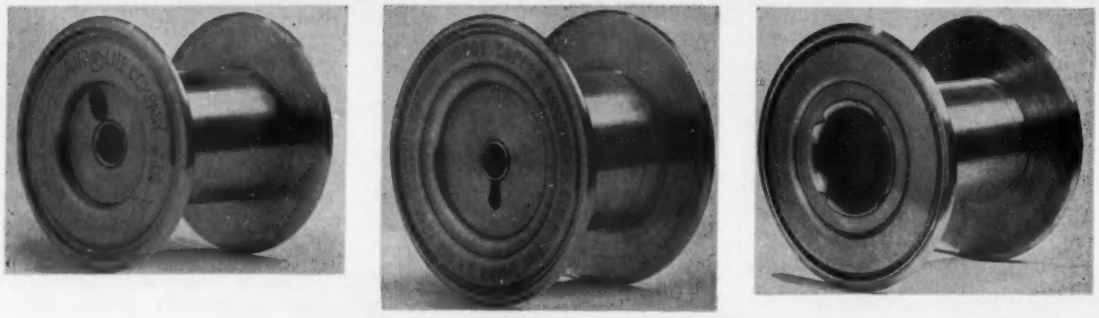


SHOWN HERE:
6 SPOOL LAYING-UP MACHINE with variable geared back turn for wire ropes from 15 mm (19/32") to 40 mm (1-9/16") diam.
Spools: 900 mm (35½") flange diam. Weight of full spool: 1000 kg (2200 lbs.)

J. A. KRAFT MASCHINENFABRIK, OLPE/WESTF., GERMANY
HANCOR, INC., 468 Fourth Ave., New York 16, N. Y.
SOLE REPRESENTATIVE IN THE U.S.A. AND CANADA

DESIGNED FOR CUSTOMER APPEAL:

HUBBARD ALUMINUM SPOOLS



NEW FEATURES

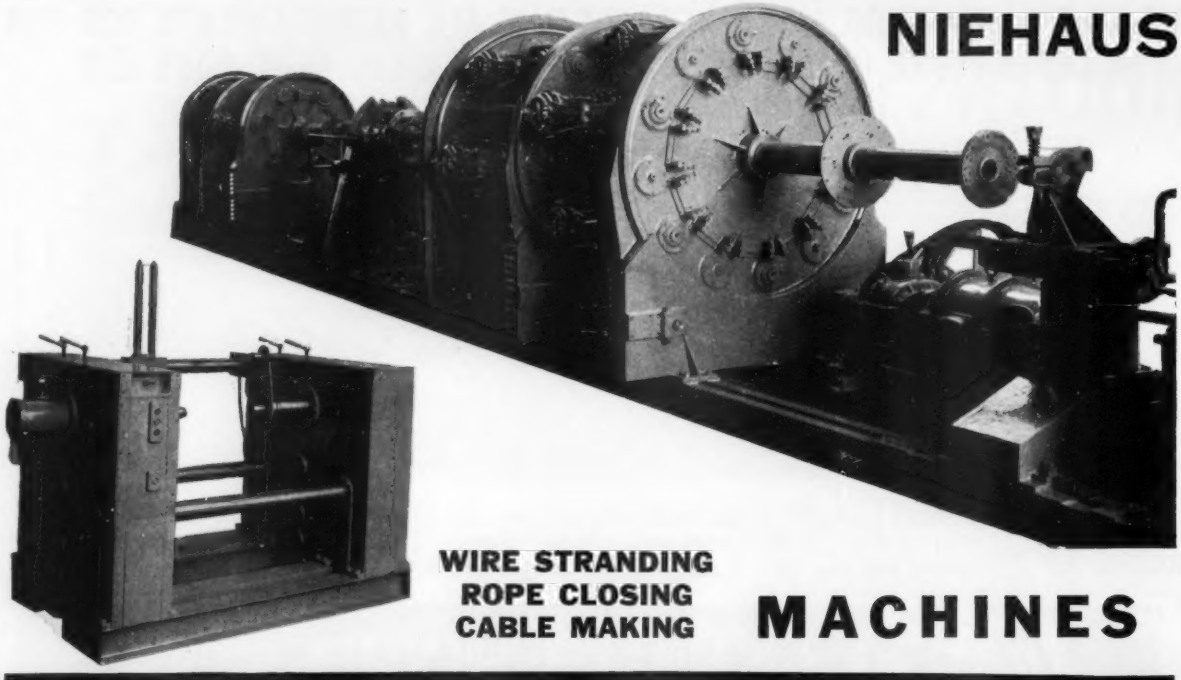
1. STRONGER ALUMINUM HEAD — NO WEIGHT INCREASE
2. WELDED CONSTRUCTION — NO OPENING AT HEAD AND BARREL
3. SMOOTH SURFACES — NO SNAGS, REDUCES WIRE SCRAP LOSS
4. UNIFORM TARE WEIGHT — IDEAL FOR BULK WEIGHING

HUBBARD SPOOL DIVISION

The American Pulley Company

TELEPHONE: GARRETT 840 **GARRETT, INDIANA**

NIEHAUS



WIRE STRANDING
ROPE CLOSING
CABLE MAKING

MACHINES

MASCHINENFABRIK K. A. NIEHAUS · DÜSSELDORF-RATH

KABELMASCHINEN DRAHTSEILMASCHINEN

Sole Representative: Paul Reicher Machinery & Equipment, P.O. Box 127, Willowdale, Ont., Canada

ing equipment, succeeding **William P. Hanks** who now is Midwestern District Manager.

★ ★ ★

Mr. Hooser formerly was associated with Cleveland Tramrail Texas Company, Dallas, Texas, and is thoroughly familiar with the sales, application and servicing of Cleveland Tramrail equipment.

Ajax Engineering Advances Officers

Dr. G. H. Clamer, President, **Ajax Engineering Corporation,** Trenton, N. J., has been elected Chairman of the Board. He is succeeded as President by **Manuel Tama. Mario Tama** has been elected Vice President.

★ ★ ★

Dr. Clamer is one of the pioneers of electric induction melting and heating whose initiative sparked the invention of the Ajax-Wyatt 60 cycle induction melting furnace for brass. He also introduced the Ajax-Northrup high frequency induction melting furnace and the Ajax-Hultgren electric salt bath furnace. In 1941, Dr. Clamer founded Ajax Engineering Corporation for the purpose of manufacturing the Ajax-Tama-Wyatt 60 cycle core type induction furnace to open new fields for 60 cycle induction melting.

★ ★ ★

Manuel Tama, long active in the representation of Ajax-Wyatt furnaces in Europe, has been Vice President and General Manager of Ajax Engineering Corporation since its inception and has been responsible for the successful development of Ajax-Tama-Wyatt induction melting furnaces in many different metal working industries, handling aluminum, copper, and zinc. In recent years, Mr. Tama introduced the Ajax-Junker 60 cycle coreless induction furnace to American industry. He holds many patents in this field.

★ ★ ★

Mario Tama, since 1942 Secretary and Research Engineer of Ajax Engineering Corporation, has been responsible for many technical developments in the field of 60 cycle induction melting and many of his patented inventions are widely used today, such as the twin-coil inductor, the electromagnetic pump, the Ajaxomatic pouring unit, 60 cycle induction galvanizing furnaces, and many others.

Escambia Adds Representative

Paul F. Baker has been named vinyl sales representative for the Midwest for **Escambia Chemical Corporation, John B. Clopton,** director of sales, has announced. He brings to Escambia the benefit of his 25 years' experience in production and technical service with the Landers Corporation of Toledo, Ohio.

★ ★ ★

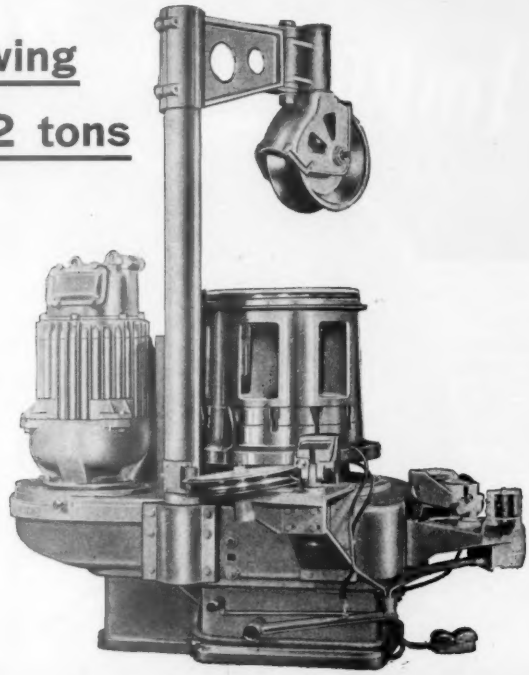
Escambia manufactures polyvinyl chloride resins for the plastics industry including Escambia

EW

Double Deck Drawing

Pulling power 12 tons

Machines for drawing by single, and multiple draftings both by dry and wet methods at high operating speeds. Automatic electric controls with or without speed regulation.



Emilio Wartenweiler

MILANO (ITALY)
VIA G. B. PERGOLESI No. 18

PVC Pearls, electrical grade and general purpose resins.

Mahon Adds to Sales Staff

Walter T. McCoy Jr., formerly an industrial sales engineer in the Chicago office of the **R. C. Mahon Co.,** has been appointed manager of the Detroit firm's New York industrial sales organization, succeeding **Eugene Bordinat,** who retired recently after 24 years service with the company.

★ ★ ★

Although a 1947 mechanical engineering graduate of the University of Michigan, Mr. McCoy actually began his engineering career with Mahon in 1938, working part time while obtaining his formal education.

Rome Cable Engineer Reviews PVC Insulation

E. Mark Wolf, assistant chief engineer of **Rome Cable Corporation,** recently reviewed the development, growth and current use of polyvinylchloride insulation for oil-filled transformer leads, in a paper presented at the National Conference on the Application of Electrical Insulation in Cleveland, Ohio, in September. Mr. Wolf is a member of both organizations.

Chief Chemist Appointed by Rockbestos

George Beuttner has been appointed chief chemist for **Rockbestos Products Corporation,** manufacturers of insulated electrical wires and cables.

★ ★ ★

Mr. Beuttner has been chief chemist of the United States Rubber Company's plant in Fort Wayne, Indiana, for the past ten years. Before his assignment to Fort Wayne, he was a member of the research staff at U. S. Rubber Company's general laboratories in Passaic, N. J., and has also been associated with the Government's Munitions Plant at Des Moines, Iowa. He is a graduate of the University of Wisconsin where he received a degree in chemical engineering.

Triangle Appoints Manager of Distributor Relations

Robert W. Gardner has joined the **Triangle Conduit and Cable Company** of New Brunswick, N. J., as supervisor of distributor relations according to an announcement from **Carl S. Menger,** Executive Vice-President. He is a graduate of U.C.L.A., class of 1948.

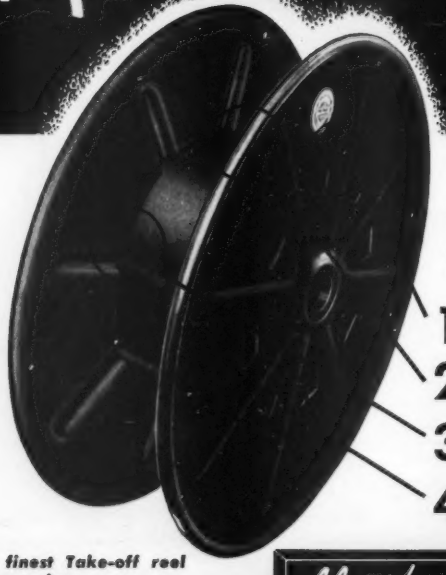
Armco Officer Becomes Director

Logan T. Johnston, executive vice president of **Armco Steel Corporation,** has been elected a member of the company's board of directors, **Charles R. Hook,** board chairman, has announced.

★ ★ ★

He joined Armco as a salesman in 1925, and most of his 33-year career with the company has been in sales work, becoming general

Important DIFFERENCES
BETWEEN JUST ANY REEL AND
All Welded MPS



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#109

manager of sales in 1947. Five years later he was elected a vice president and was made executive vice president earlier this year. He is a native of Pittsburgh and a 1923 graduate of Carnegie Institute of Technology.

Riverside-Alloy Appoints Sales Executive

Loy Collingwood has been appointed Assistant General Sales Manager, **Riverside-Alloy Metal Division, H. K. Porter Company, Inc.,** according to an announcement by **F. H. Conant,** Division General Sales Manager.

★ ★ ★

In his new assignment, he will act as liaison between the Division's home office sales staff and Riverside-Alloy's various district offices. He will move from his present Detroit headquarters to the Division's general offices in Riverside, N. J.

★ ★ ★

He is a graduate of the Augusta Military Academy and received an Engineering Degree from the University of Pittsburgh. He also undertook graduate studies at Michigan State and Northwestern Universities.

Roswell L. Hamaker

Roswell L. Hamaker, a district sales representative of **Warner Company,** passed away on September 8th. A resident of Scarsdale, New York, he is survived by his wife, a son and daughter.

★ ★ ★

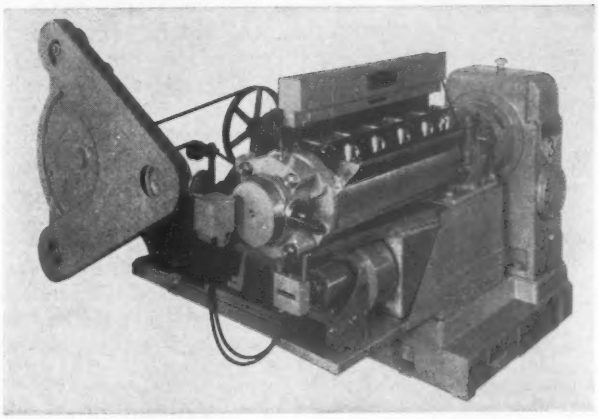
Mr. Hamaker's association with Warner goes back almost half a century, to 1909, when he went to the firm's Cedar Hollow lime plant in Chester County, Pa., to learn the lime business. At the end of a year he joined the sales force, selling agricultural and building lime throughout New York State.

★ ★ ★

In 1912 he left the company to join the Security Cement and Lime Company which later merged with the North American Cement Corporation, working from this firm's offices in Pittsburgh, Buffalo, Hagerstown, and Philadelphia. He managed the Philadelphia office until the outbreak of World War I, and after the war became associated with the National Lime Association in Washington.

★ ★ ★

In 1927 Mr. Hamaker again became associated with Warner, this connection lasting until his death. He again served as a district sales representative for lime products, his territory covering New England, New York, and northern New Jersey. "Hamy", as he was called, had been a member of The Wire Association from the time of its formation, and was well-known in wire circles, as his company was the principal supplier of lime for casting steel rod.



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Winds Association Clock for 1959

The Wire Association was honored on October 31, 1958, to have **Harold W. Rigby,** Chairman of Directors, John Rigby & Sons Ltd., Low Moor, Bradford, England, call at its offices in Stamford, Connecticut, to wind the lovely grandfather clock that graces its headquarters.

★ ★ ★

The handsome clock, which runs for 400 days upon being wound, was the gift of our British members to the Association in appreciation of all the courtesies and services that had been rendered to them over the years. It was formally presented to the Association in 1948 during the Annual Convention held in Pittsburgh that year by **John Rigby.** Director of John Rigby and Sons Ltd.

★ ★ ★

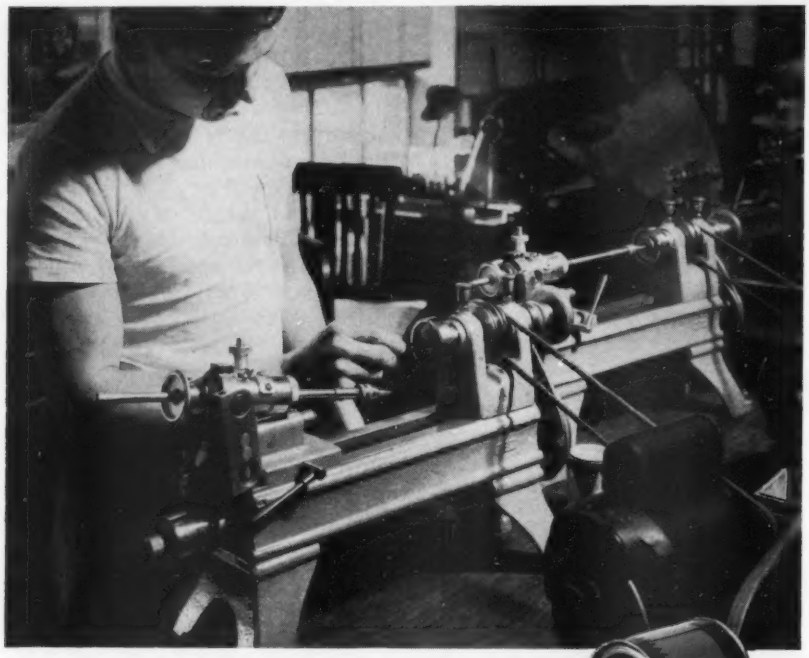
It seems most appropriate, at the end of a ten year cycle, that it should have been wound by another Rigby. Mr. Harold Rigby, who had been in this country for approximately one month and who was present at the Annual Convention in Atlantic City, N. J., was driven to our office by William E. Hitchcock, Jr., President of the Atlantic Wire Company of Branford, Conn. Mr. Rigby was accompanied by his charming wife.

Harold W. Rigby

After the ceremony of winding the clock, which is done each year by an English member, the Rigbys were entertained for two hours before they entrained for New York City, where they stayed before sailing for England on November 6th. Mr. Rigby's name has been inscribed on the scroll that hangs beside the clock, which bears the name of those persons who have so graciously performed this function each year.

★ ★ ★

Mr. Harold Rigby's last visit to the United States was in 1938, at which time we had the pleasure of his company at the Annual Convention held in Detroit, Michigan.



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A.S.M. Announces 17 Metals Study Courses

The American Society for Metals, through its division, the **Metals Engineering Institute,** has announced a series of home study and inplant courses on 17 metals subjects. For a free catalog address the Metals Engineering Institute, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

Annealings and Dies in Process Drawing of Wire

(*Continued from page* 1468-B)

Set slide index to 71 on A scale right, opposite 166 on D scale read 197 on C scale.

★ ★ ★

Answer c: The wire that does not slip at the first drum after being drawn thru the first die is of .197 in. dia.

★ ★ ★

Solution d:

5. Find the per cent slippage of the given base wire .210 in. dia. at the first drum when drawn thru the first die, by using Equation 17 and d_o found above:

$$S = 1 - (d_b/d_o)^2$$

$$= 1 - (.197/.210)^2 = 0.12$$

★ ★ ★

Answer d: The slippage at the first drum is 12 per cent.

VII. Diameters of Step-Cone Drawing Block

The diameters of the steps of a cone-shaped block for multi-drawing, must be precisely calculated in order to avoid slippage or breakage of the wire. If the diameter of the last step D_n and the per cent remainder in area per single pass C_1 are given, the diameter of the preceding step D_{n-1} can be found, using the following equation:

$$D_{n-1} = D_n \times C_1 \qquad \text{Eq. 18}$$

★ ★ ★

The per cent remainder in area per single pass C_1 of a n-step-cone drawing block, where the diameter of the 1st and n-th steps are given, is found by the following equation:

$$C_1 = \sqrt[n-1]{D_1/D_n} \qquad \text{Eq. 19}$$

★ ★ ★

The following example shows the applications of these equations.

★ ★ ★

Example: A cone-shaped drawing block has nine steps, the last one being 20.000 in. dia.; the reduction between steps is 15 per cent. What are the diameters of the steps?

Solution:

1. Find the single per cent remainder in area, using Equation 4.

$$C = 1 - R = 1 - 0.15 = 0.85$$

2. Find the diameter of the steps of the drawing blocks, by using the slide rule as follows:

Set right index of C scale on 85 on D scale,

opposite 200 on C scale read 170 on D scale,

opposite 170 on C scale read 1445 on D scale,

opposite 1445 on C scale read 1228 on D scale,

opposite 1228 on C scale read 1044 on D scale,

opposite 1044 on CF scale read 887 on DF scale,

opposite 887 on C scale read 754 on D scale,

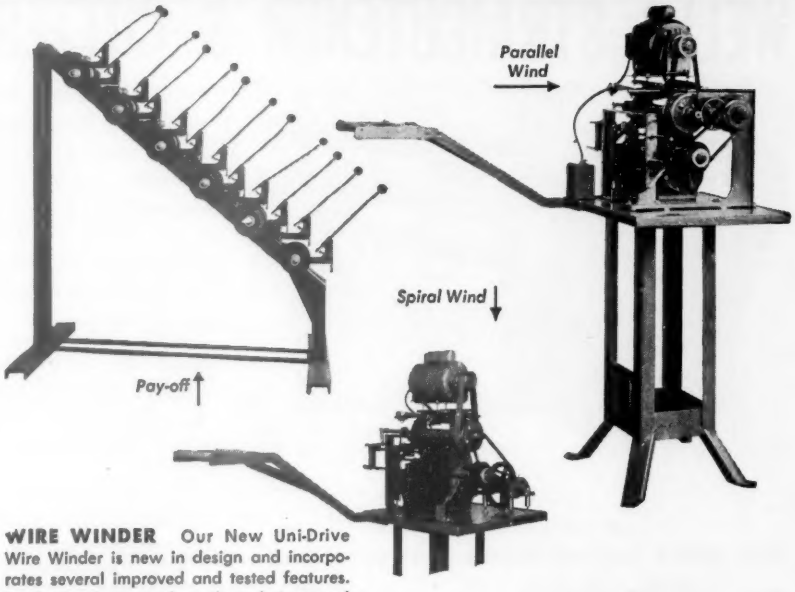
opposite 754 on C scale read 641 on D scale,

opposite 641 on C scale read 545 on D scale.

★ ★ ★

Note that opposite 1044 on C scale there is no number on D scale. The required smaller number was found on DF scale opposite the larger number on CF scale. Again, by using the CF and DF

STANDARD UNI-DRIVE WIRE WINDER



WIRE WINDER Our New Uni-Drive Wire Winder is new in design and incorporates several improved and tested features. Production is stepped up through increased speed. It produces smooth, even and accurately wound spools of wire in single or multiple ends. All strands parallel — no over or under-winding. Can also be furnished with a slight spiral pattern for winding exceedingly fine wire. Automatic Stop Motion controls each strand. Traverse adjustable from 1¾" to 5½" between spool heads without changing cam. Designed especially for winding wire to be braided and shielded for electrical conductors.

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PAY-OFF Our Pay-off Attachment consists of a heavy fabricated frame on which Pay-off spools are mounted to cover desired number of ends to be wound. Equipped with spindles, running on self-aligning ball bearings, with size of spindles and adapters to accommodate customers' pay-off spool. Compensating Attachment to control the tension of each individual strand of wire, applying the same tension when spool is full as when empty. Can also be adapted for use with bunching machines.

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scales one saves the trouble of moving the slide (cf. Example 6).

★ ★ ★

The solution may be checked by applying Equation 19, as follows:

$$C_1 = \sqrt[8]{5.45/20.0} = 0.85$$

Solution: The diameters of the steps are 20.0, 17.0, 14.45, 12.28, 10.44, 8.87, 7.54, 6.41, and 5.45 in. dia.

★ ★ ★

In cases where greater precision of the diameter is required the calculations must be done using logs and the slide rule method may serve as a check.

Summary

Process economy and the need for the best physical properties in metals and alloys demand a mathematical approach to the selection of annealing steps and die sizes. Basic algebra and the use of practical slide rule methods make seemingly tedious and difficult wire drawing and processing problems easy and rapidly solved.

Acknowledgement

The writer is indebted to **Dean T. Stephen Crawford** for permission to write this paper. Thanks are due to **Mr. A. W. Keuffel,** Vice-President of Keuffel & Esser Co., Hoboken, N. J. who by his personal interest in these problems stimulated this article and contributed useful suggestions.

References

(1) F. A. Mohrnheim, "Practical Slide Rule Method for Calculating Percentage Reduction in Area in Working and Testing of Rod and Wire"; Wire and Wire Products, 32, p. 1495-97, 1522-24 (Dec. 1957).

(2) Crum, E. J., The Graphical Solution of Wire Mill Mathematical Problems; Wire and Wire Products, October, 1943.

(3) Crum, E. J., The Crum Calculator for Wire Drafting; 21, 221-223, 253-254, March, 1946.

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Friedrich Kohlhase, Universal Special Slide Rule "Wire," Aristo Works, Dennertz Pape, Hamburg-Altona, Germany.

(5) F. A. Mohrnheim, "How to Plan and Analyze Tube Drawing," to be published.

(6) Keuffel & Esser Co., "LOG LOG DUPLEX DECITRIG Slide Rule No. 4081," Hoboken, N. J. (1955).

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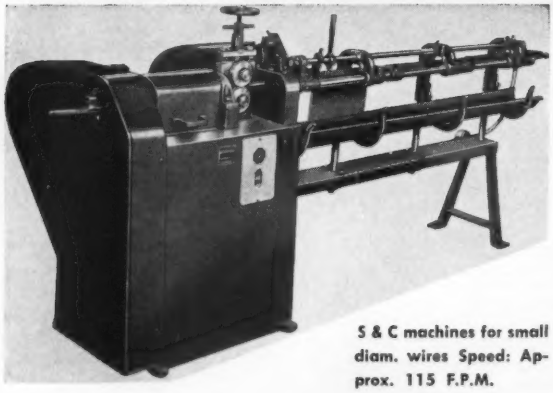

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★ ★ ★

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For further information, engineering assistance and samples, inquiries should be addressed to the Jacobson Nut Mfg. Corp., Box 177, Kenilworth, N. J.

ALUMINUM INGOT AND MILL PRODUCTS AND MAGNESIUM MILL PRODUCTS: July 1958

(Shipments and receipts are in thousands of pounds)

Item	Number of companies reporting shipments	July 1958			June* 1958 net shipments	July 1957 net shipments
		Gross[1] shipments	Receipts[2]	Net[3] shipments		
ALUMINUM MILL PRODUCTS, TOTAL	152	253,488	23,912	229,576	228,266	249,588
Sheet and plate, non-heat-treatable	31	104,361	19,275	85,086	83,990	93,340
Sheet and plate, heat-treatable	4	(D)	(D)	18,940	19,830	20,247
Foil, including foil in lamination	14	14,874	94	14,780	14,609	17,037
Rolled, and continuous cast, rod and bar[4]	5	10,973	3,519	7,454	5,066	13,856
Wire, bare, conductor and nonconductor	15	4,093	168	3,925	3,599	5,004
ACSR and aluminum cable, bare	11	(D)	(D)	16,231	16,034	16,620
Wire and cable, insulated or covered	13	4,522	...	4,522	3,975	4,495
Extruded shapes, soft alloys	95	63,395	826	62,569	62,123	59,410
Extruded shapes, hard alloys	9	4,264	...	4,264	4,250	4,685
Drawn tube, soft alloys	12	4,364	...	4,364	5,563	5,303
Drawn tube, hard alloys	8	[5]981	...	[5]981	[5]2,659	[5]1,849
Welded tube, non-heat-treatable						
Powder and paste:						
Atomized and grained powder	3	715	...	715	687	715
Flaked powder	5	307	...	307	239	382
Paste	5	1,620	...	1,620	1,524	2,023
Forgings (including impact extrusions)	16	3,818	...	3,818	4,118	4,622
MAGNESIUM MILL PRODUCTS, TOTAL	10	(D)	(D)	1,227	1,709	1,428

*Revised.

D Withheld to avoid disclosing figures of individual companies. These figures are included, however, in the appropriate total.

[1]Gross shipments of mill products represent total shipments by producers to customers, including other producers, and shipments by producers to their own fabricating departments which manufacture products beyond the level of mill shapes. Ingot gross shipments include shipments by importers.

[2]For mill products, represents receipts from domestic producers only. In addition to receipts from domestic producers, 17,000 pounds of mill shapes were received through imports. For ingot, receipts from imports are included.

[3]For mill products, derived by subtracting the sum of producer's domestic receipts of each mill shape from the industry's gross shipments of that shape. Ingot data derived by subtracting all receipts from shipments reported.

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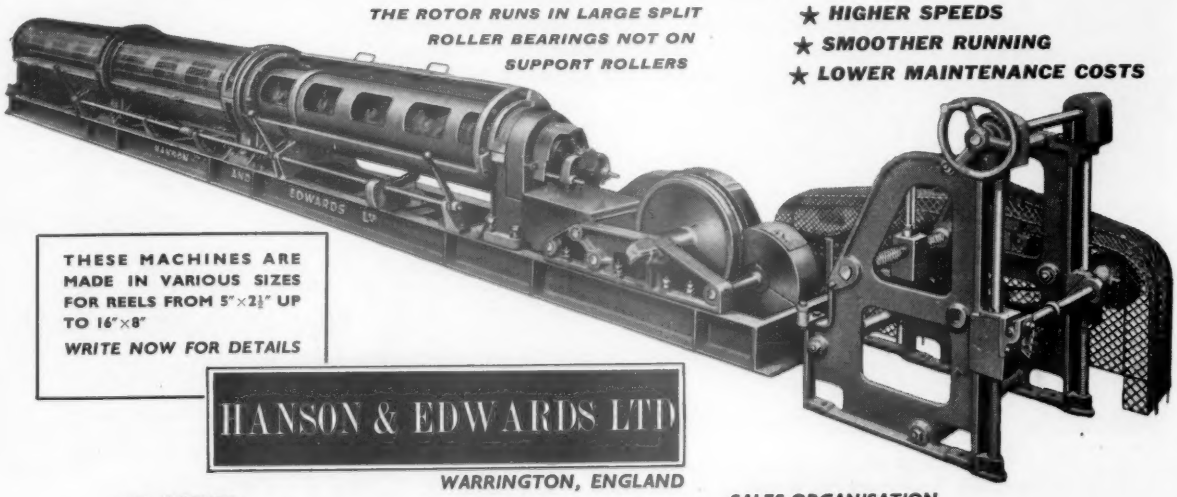

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P 1686

A Review of Recent Wire Patents

The data listed below is only a brief review of recent patents pertinent to the readers and subscribers of this publication.
Complete copies of these patents may be obtained by writing to the publisher of this magazine and remitting 50c for each copy desired. For orders received from outside the United States the cost will be $1.00 per copy.

No. 2,854,674, BED SPRING CONSTRUCTION, patented October 7, 1958 by Louis Elliott Frey, Los Angeles, California.

★ ★ ★

The inventor provides a wire spring edge construction for a bed spring structure, including a sinuously corrugated wire spring extending around all the upper edges of the structure and interwoven with the upper wire side and edge frame members.

★ ★ ★

No. 2,855,045, WIRE HANDLING APPARATUS, patented October 7, 1958 by Gerard A. Frank, Allentown, Pa., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

More specifically, this apparatus is a fixture for automatically loading uniform lengths of wire in holders having clamping means for receiving the wire, with the holder supported by the fixture.

★ ★ ★

No. 2,855,159, MULTIPLE SPINDLE WIRE WRAPPING TOOL, patented October 7, 1958 by Rudolph F. Mallina, Hastings on Hudson, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York.

A device is disclosed for simultaneously making a number of wrapped electrical connections.

★ ★ ★

No. 2,855,631, METHOD OF PREPARING WIRE INSULATED WITH A VINYL RESIN, patented October 14, 1958 by Arthur C. Rowley, Stratford, Conn., assignor to General Electric Company, a corporation of New York.

The method comprises mixing a polyvinyl resin with a liquid plasticizer to produce a plastisol, introducing said plastisol to an extrusion apparatus, heating said plastisol to fusion temperature in the barrel of said extrusion apparatus, and extruding the fused plastisol as insulation onto a conductor.

★ ★ ★

No. 2,855,985, WIRE SPRING STRUCTURE, patented October 14, 1958 by William H. Neely, Cleveland, Ohio, assignor to The Universal Wire Spring Company, Bedford, Ohio, Corporation of Ohio.

In this wire spring structure, the ends of web-reinforcing auxiliary wire members are coupled in cantilever-like fashion with wire spring webs by interlacing these ends with at least two adjacent cross wire members of the webs and the middle portions of the auxiliary wire members are spaced from these webs preferably by bending these middle portions in a direction away from the webs.

★ ★ ★

No. 2,856,093, WIRE CARRYING CASE, patented October 14, 1958 by Robert A. Bruce, Keosauqua, Iowa, assignor to Barker Equipment Company, Keosauqua, Iowa, a corporation of Iowa.

There are 11 claims to this patent for an open wire work basket, composed of wires of different sizes and of sheet metal corner members.

★ ★ ★

No. 2,856,107, TIE FORM, patented October 14, 1958 by Harry B. Shiller, New York, N. Y.

A necktie former is provided comprising an elongated U-shaped body of light gauge round spring wire having loops on the free ends of the leg portions thereof.

★ ★ ★

No. 2,856,453, PORTABLE CONTROL CABLE WITH CREPE PAPER SEPARATOR, patented October 14, 1958 by Robert O. Shepp, San Leandro, Calif., assignor to General Electric Com-

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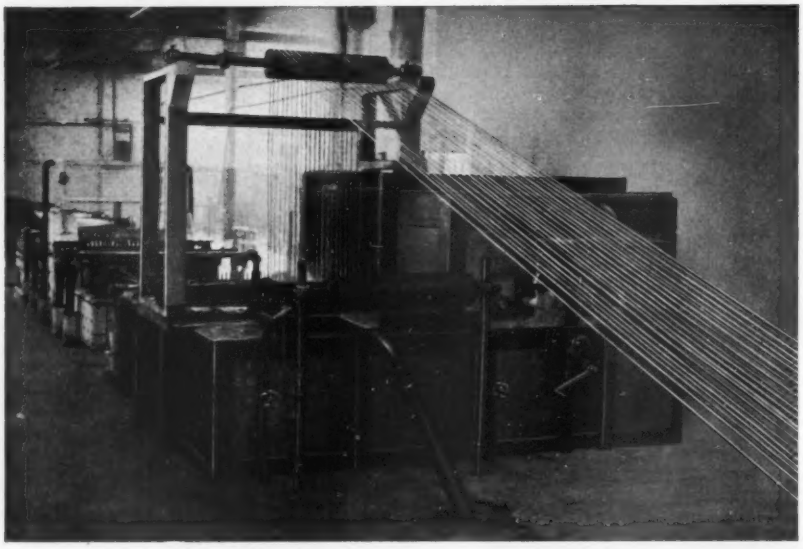

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Operation by Gas or Oil

SOLE REPRESENTATIVE:
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COVER HEATED **galvanizing furnace for wire**
(German and Foreign Patents issued)

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pany, a corporation of New York.

The insulated wire conductors have a spirally-wound layer of crepe paper tape about them having two crepings substantially perpendicular to each other so that the tape is capable of stretching in all directions to furnish a uniform resistance to the opening of the conductors when the cable is twisted.

★ ★ ★

No. 2,856,691, DEVICE FOR MEASURING THE LENGTH OF COILS OF STRIPS OF UNIFORM THICKNESS, patented October 21, 1958 by Georges Pattantyus, Lisbon, Portugal.

The device comprises a disk provided on its surface with a number of uniformly spaced bores, and driven at a predetermined ratio together with the rotation of the coil, a wheel having cone-shaped protrusions provided around its rim, these protrusions engaging the bores, a shaft arranged in a radial direction above the disk, with the wheel being displaceable on said shaft in an axial direction, a calibrated scale, and a pointer movable by the shaft over the scale.

★ ★ ★

No. 2,856,914, STONE SAWING WIRE, patented October 21, 1958 by Joseph Theodore Dessureau and John B. Dessureau, Barre, Vt.

A flexible stone sawing cable is disclosed, composed of two spirally twisted strands of half-round and half-square wire, the strands being of the same cross sectional size and each having flat and parallel side faces, a semi-circular inner face which merges into the side faces and forms the half-round portion of the strand, and a flat outer face at right angles to the side faces and forming with the latter the half-square portion of the strand.

★ ★ ★

No. 2,856,987, SPRING CONSTRUCTION, patented October 21, 1958 by Joseph L. Lelli, Birmingham, Mich., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware.

The improvement comprises rows of sinuous spring braces with each brace being directly connected to spaced portions of a respective sinuous wire spring element in angularly disposed relation to and directly below a platform portion thereof, the braces of neighboring elements having a crisscross relation with each other to stabilize the load supporting surface of the assembly against a lateral shifting movement under load, with the spring action of the bracing serving to supplement the spring action of the elements. There are 10 claims.

★ ★ ★

No. 2,856,989, SPRING CUSHION CONSTRUCTION, patented October 21, 1958 by Edward T. Pawlikowski, Argo, Ill., assignor to Rockwell-Standard Corporation, a corporation of Pennsylvania.

A zig-zag spring cushion construction is disclosed having a base and top layer of springs comprising in combination a number of parallel sinuous spring strips spanning in successive arches across the base and having V-shaped supporting portions at the ends.

★ ★ ★

No. 2,857,000 APPARATUS FOR INTERMITTENTLY ADVANCING AND CUTTING LENGTHS OF WIRE AND THE LIKE, patented October 21, 1958 by Robert W. Swanbum, deceased, late of Duluth, Minn., by Gerda J. Swanbum, executrix, Duluth, Minn.

The apparatus is of the class including a feed wheel fixedly mounted on a shaft for rotation therewith, a pinch wheel journaled in a frame circumferentially adjacent and spaced from the feed wheel, the space between adjacent circumferential portions of these wheels defining a pass having an entry end and an exit end for wire being processed. A raised rim portion is provided for the feed wheel to advance the wire.

★ ★ ★

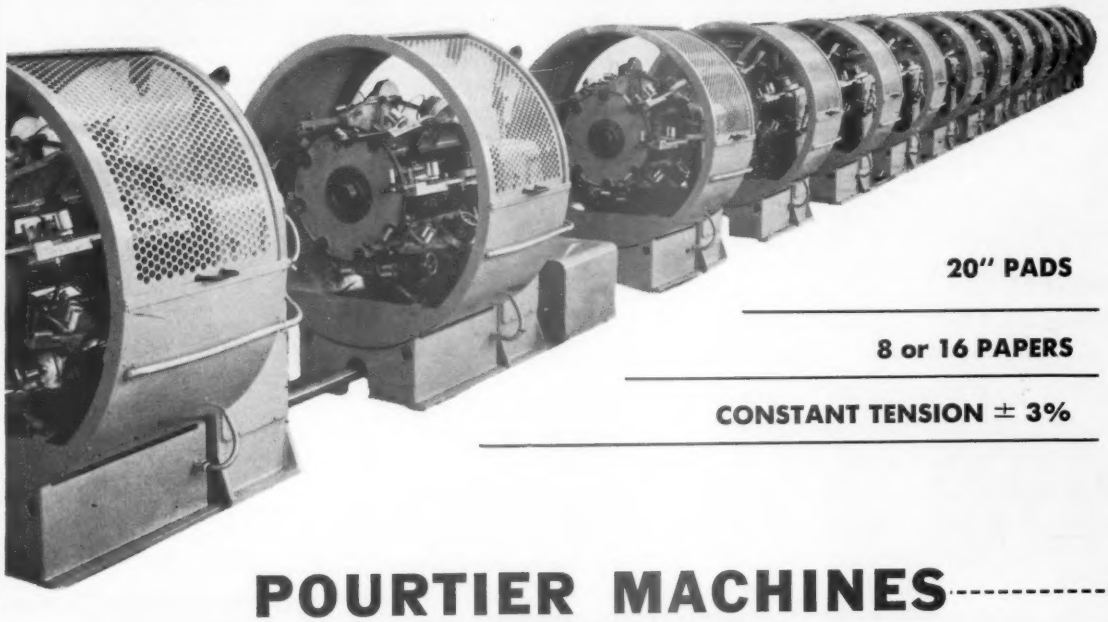
No. 2,857,112, TOROIDAL WINDING MACHINE, patented October 21, 1958 by Raymond W. Tibbetts, Camden, Maine, assignor to Tibbetts Laboratories, Inc., Camden, Maine, a corporation of Maine.

A container of liquid is included in this machine with a bobbin ring carrying the wire and having a portion immersed in the liquid, whereby the liquid prevents the loops of wire from twisting or tangling while being drawn around the core being wound.

★ ★ ★

No. 2,857,115, APPARATUS FOR HANDLING COILED METAL STOCK,

HIGH VOLTAGE LAPPING MACHINE



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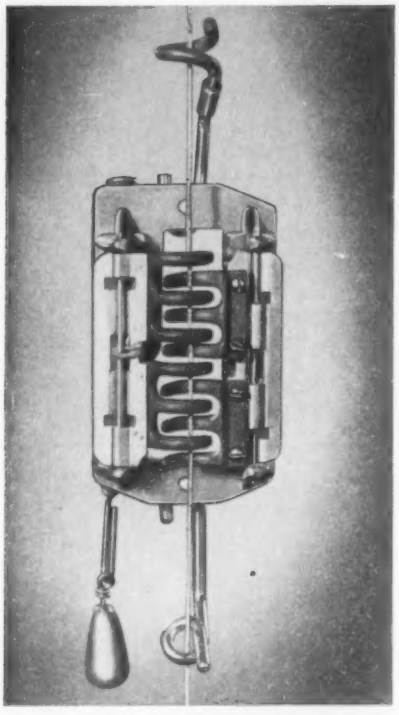

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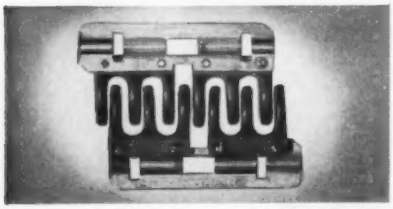

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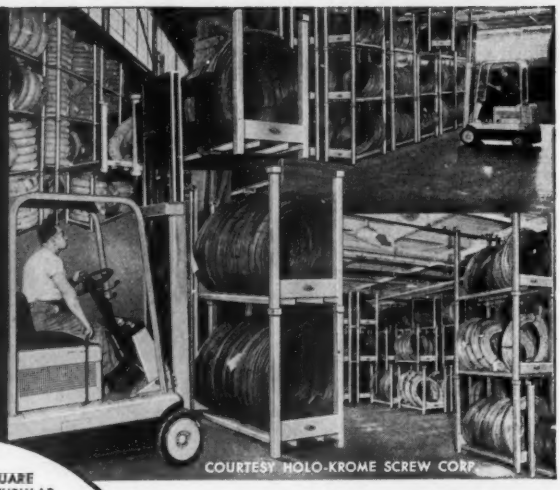

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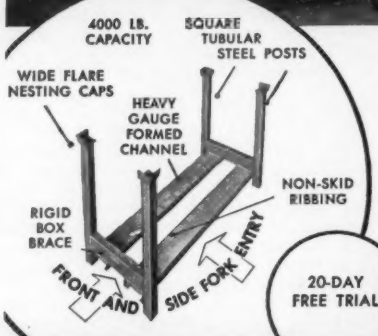

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patented October 21, 1958 by Robert B. Foulks, Spokane, Wash., assignor to Kaiser Aluminum & Chemical Corporation, Oakland, Calif., a corporation of Delaware.

A coil elevator apparatus of the type to be disposed beneath a coiling mandrel is provided upon a support table. There are 11 claims.

★ ★ ★

No. 2,857,116, PACKAGING OF WIRE, patented October 21, 1958 by Frederick B. Krafft, Frank K. Roberts, and Leo Lorenz, Muskegon, Mich., assignors to Anaconda Wire and Cable Company, a corporation of Delaware.

The method is adapted to package flat spiral coils of wire disposed one over another in an annular portion of a cylindrical container.

★ ★ ★

No. 2,857,117, WIRE WINDING AND UNWINDING ATTACHMENT FOR TRACTORS, patented October 21, 1958 by Gaylord Hendrix, Piatt County, Ill.

A wire-winding reel structure is provided for removable connection with an outwardly-opening cup-form pulley.

★ ★ ★

No. 2,857,350, ELECTRIC CABLE AND CONDENSER INSULATION INCLUDING FISCHER-TROPSCH WAX, patented October 21, 1958 by Archibald Walter Thompson and Albert Sidney Freeborn, Crayford, England, assignors to Dussek Brothers & Company Limited, Crayford, England, a British company.

The wire conductor has a fibrous material covering impregnating mineral oil containing between 15% and 60% by weight of a synthetic Fisher-Tropsch hydrocarbon wax having a molecular weight of approximately 600, a melting point between 85°and 120°C. and low dielectric loss, together with from 1% to 40% by weight of at least one compound selected from the group consisting of polyisobutylene having a molecular weight of approximately 100,000 and polyethylene having a molecular weight of approximately 2500.

★ ★ ★

No. 2,857,603, STABILIZER AND EDGE SUPPORT FOR COIL SPRINGS, patented October 28, 1958 by Murray J. Rymland, Baltimore, Maryland.

A particular object of this invention is to provide means for bolstering and strengthening the edge portions of a spring cushion assembly constructed with rows and files of prearranged coil springs.

★ ★ ★

No. 2,857,735, METHOD OF MANUFACTURING WIRE STAPLES, patented October 28, 1958 by Stephen J. Mashi, Bradford, Westerly, R. I., assignor to Bostitch, Inc., Stonington, Conn., a corporation of Rhode Island.

It is stated that the method minimizes diminishment of the cross sectional area of the wire at the points of bending in forming a U-shaped staple.

Bakelite Company Name Changed

Union Carbide Corporation has announced the establishment of a new name for its Plastics Division.

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The Standard of the Wire Industry

As of November 15, **Bakelite Company** became **"Union Carbide Plastics Company."** This change is another step in the program initiated last year by Union Carbide to cement corporate identity with its broad range of products.

★ ★ ★

The Plastics Company, according to **R. K. Turner,** President, will continue to produce and sell a full line of products under the familiar "Bakelite" and other well-known trademarks.

★ ★ ★

J. D. Benedito, Vice President—Sales, announced a sales organization "keyed to customer service" for the newly named Plastics Division. He also announced the appointment of **J. L. Rodgers** as Director of Sales, and **T. W. Sharp** as Director of Product Marketing. Mr. Rodgers will be in charge of Product Selling Operations and Mr. Sharp will be responsible for Planning and Specialized Marketing functions.

Wire Pickling

(*Continued from page* 1487)

added produces a favorable effect, appreciably lessening the tendency to the above-mentioned results. It is obvious that from the standpoint of economics there is a reduction of expense. The addition of inhibitors is possible to both hydrochloric and sulphuric acid baths.

★ ★ ★

Of the various inhibitors in use, we will only mention one called "Ferhibit". According to the producing firm, the addition of 0.05% to the volume of the bath will so affect it that only the scale is dissolved while the metal itself is not attacked, resulting in a saving both of metal and acid. On the average, a 5% saving of material can be counted on. The value of this saving of material in the pickling process is too often overlooked. As is well known, it can happen that material sensitive to acid attack can be overpickled, so that rejects are increased. The pickling time is shortened. The inhibitor can be used in a variety of types, one being foam-free and

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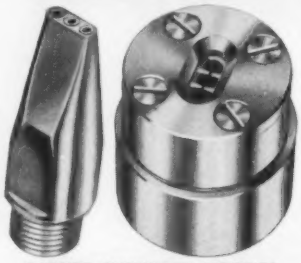

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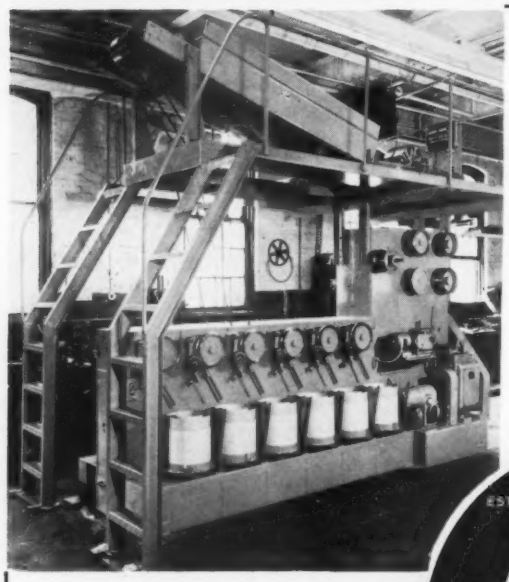

Left: **Barrell Take-up No. 1237, B&S Gauge 20 to 30, for enameling machine with preannealer.**

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MANUFACTURERS OF WIRE INSULATING MACHINERY AND ALLIED EQUIPMENT. MACHINERY MFG. TO CUSTOMERS SPECIFICATIONS.

another causing a foam cover over the bath. Most practice favors the foam-free type. The formula of the bath can include any desired concentration, which is so chosen as to accord with service requirements. In general, however, it is aimed to shorten the pickling period.

The Sulphuric Acid Pickle Used for Wire Rod

The pickling of wire rod is in general effected in sulphuric acid baths. A particularly favorable composition, giving a sulphuric acid content of about 20% by weight, is provided by the following:

231 gals. of water
33 gals. sulphuric acid 66° Bé
½ Qt. inhibitor ("Ferhibit")

★ ★ ★

This mixture has the advantage that with this acid concentration the bath heats up of itself to a temperature of from 113°F. to 122°F. and pickling can be begun at once.

Pickling Annealed Wire

Somewhat weaker baths are used for annealed wire. Here a bath with about 10% by weight of acid will suffice, so that every 264 gals. will have:

248 gals. of water
16 gals. of sulphuric acid 66° Bé
½ qt. of inhibitor

★ ★ ★

The essentially greater sensitivity of steel wire to acid requires a weaker acid concentration. The use of the inhibitor "Adacid" is treated by Steinmüller in "Draht-Welt-Buch" (published in 1956). He also cites several other brands now on the market.

The Disadvantage of Former Pickling Without an Inhibitor

The introduction of the use of inhibitors has practically eliminated the older pickling process. This older process goes beyond an increased consumption of acid to an ill effect upon the wire surface. Keller (in "Handbook of Metal Pickling") advises that loss of

metal through pickling was formerly from 48 to 66 pounds per ton of rod, whereas today it amounts to only 18 to 33 pounds. Moreover, this excessive loss of metal was accompanied by a health hazard to the worker. Metal loss compared with a yearly German production of 600,000 tons amounted to some 9,000 tons, equal to the entire production of an average wire mill. This meant also the unnecessary consumption of some 17 or 18 tons of sulphuric acid. Keller suggests that some such calculation led to the recognition of the economic advantage in use of an inhibitor.

Descaling With Sodium Hydride

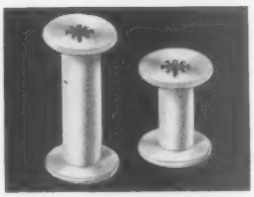
Prof. Dr. W. Fuchs has carried out valuable researches into this matter. His work* pertains to the descaling of wire with sodium hydride. The process has been in use in America for some time. Fuchs writes, "As bath liquid, anhydrous sodium hydroxide is used in a container made of mild steel plate. The sodium, introduced into the fluid solution in an appropriate manner, melts on the surface of the caustic soda and, together with the hydrogen led in from below, forms sodium hydride, that dissolves homogeneously in the sodium hydroxide fluid solution." Fuchs claims that this process shortens the pickling time. Only the oxide (scale) is reduced, "no reaction following upon the metal underneath." After passage through the sodium bath the wire is rinsed first with water, then treated with dilute sulphuric acid, again rinsed and finally coated with a borax solution. The metal base is not affected. Advantageously, sodium hydride is applied in melted anhydrous sodium hydroxide.

★ ★ ★

In the case described the sodium hydride process was used to pickle patented steel wire under 1 mm. diameter, in place of the sulphuric acid process. In the sodium hydride process one aims at an installation secure against entrance of air, with a bath of small volume.

* Untersuchungen über neve Beizmethoden. Westdeutscher Verlag. Köln (Cologne) 1954.

PLAMENCO Nylon SPOOLS



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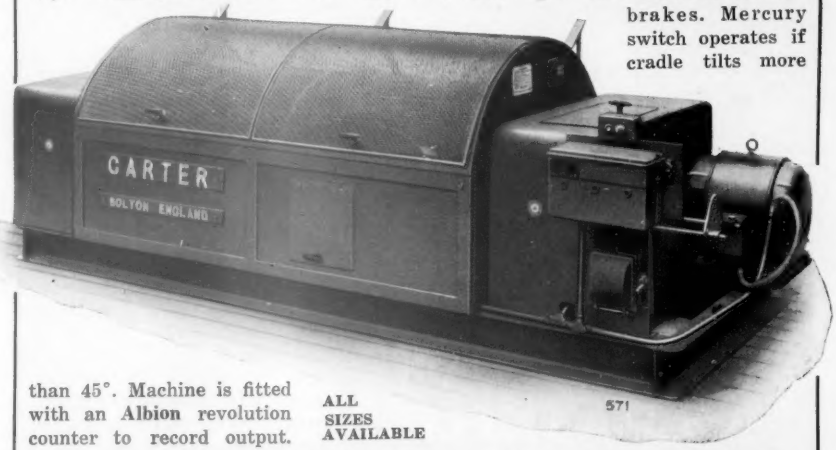

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From this it follows that a method of introducing the wire must be devised and the small capacity, in consideration of the short dipping time of 20 seconds, must be compensated by a high withdrawing velocity. This is accomplished by dipping a filled reel of wire into the bath. 176 lbs. of wire is coiled on a reel, corresponding to a length of 55,500 feet of wire, 0.9 mm. in diameter. The most favorable dipping time for the reaction is 20 seconds, if the wire is brought to the same temperature as the bath before dipping. A cold dipping results in spattering of the liquid bath and unnecessary heat losses.

* * *

The process recommended by Fuchs deserves a thorough testing. He is interested to find a means of avoiding or at least diminishing the industrial waste water with its dangers. After the test wire had passed all the baths it was led through a 7-foot long gas-heated drying furnace and then coiled. (The reader is referred to the Fuchs publication for further details.)

Control of the Acid Concentration

The effectiveness of a pickling bath is determined by two components: first, by the acid content and second, by the iron content. A freshly prepared bath contains a predetermined percentage of sulphuric or hydrochloric acid and no iron salts. With continued pickling the solution of scale continually adds more iron salts as the acid content diminishes. A limit is set to the concentration of iron salts and failure to keep within the limit induces unfavorable results in the further working of the pickled material. This limit is about 100 grams of iron to a liter of pickle solution. If a pickle bath is to be wholly utilized, then the acid strength must be worked down as low as possible in the production of the iron content so that no still useful quantity of acid shall go unused into the waste water. Generally a pickle bath is

used with an acid content of from 2 to 3%. As the chemical analysis of the iron content in practice is somewhat circumstantial, one can be satisfied with the determination of the density of the pickle investigated, that being ascertained by use of the customary hydrometer. The acid content can be determined with an acidimeter.

Acidimeter is Used for Determining the Acid Concentration

For this a very simple apparatus is available, either for sulphuric or hydrochloric acid baths. The right measuring cylinder must be used, however, as there is a difference between those for the two acids. The cylinder is first filled with the pickle to be tested, the filling being done through a funnel. As soon as the cylinder is filled up to the lower line, a test solution is poured with continuous stirring into the cylinder until the contents are colored green.

★ ★ ★

The height of the liquid at that point is measured on a scale on which the acid content can be directly read. The action of the acidimeter rests on the fact that the acid is neutralized by the test solution added. In the instant when the last drop of acid is neutralized the iron salts present in the pickle are precipitated and cause the color change. If a freshly prepared pickle bath is tested that as yet contains no iron salt, it is necessary to add to the investigated acid, before application of the test solution, one to two drops of Phenolphtalein solution. In this case the color changes not to green but to red. The scale reading gives the percentage by weight of the sulphuric or hydrochloric acid. Special apparatus is made for this purpose.

The After Treatment is Especially Important

The pickled wire needs a good after treatment, since it is not ready for use as it comes out of the bath. It must be cleaned, as all too often scale or acid still adheres. The most thorough treat-

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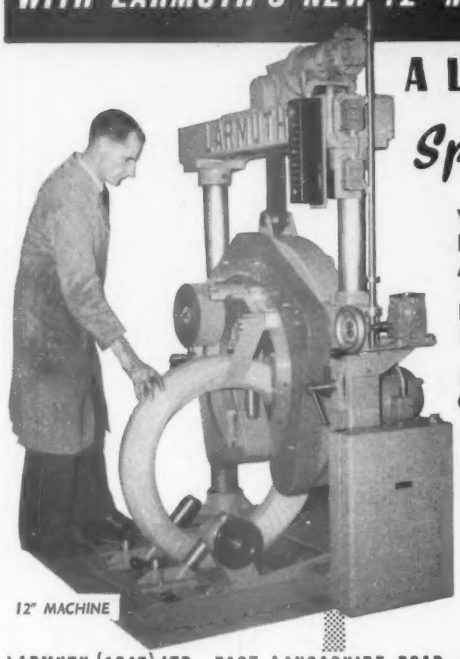

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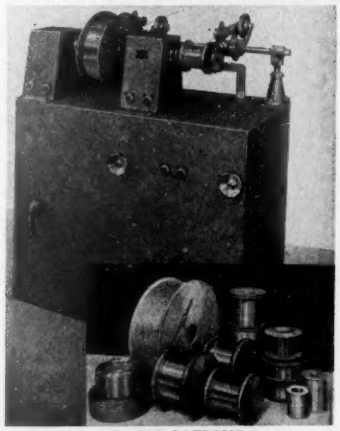

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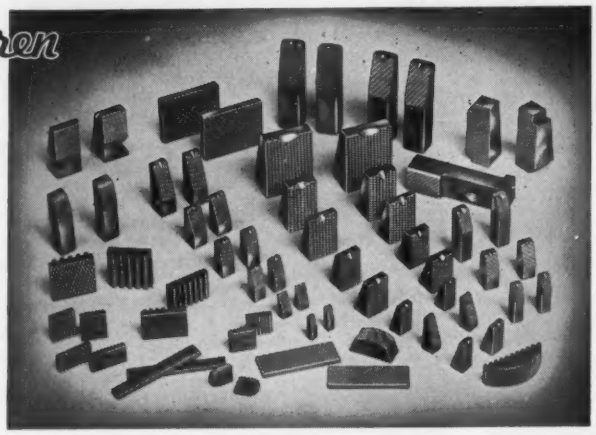

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ment is imperative to prevent these from drying fast. The wire is dipped in a water container. Frequently luke-warm water is used. Spraying off should absolutely not be omitted, especially if it turns out that the flushing as a result of the prevailing conditions promises no distinct advantages. The question of economy will also govern here. Then follow with lime-coating and drying.

Details of the Pickling

The pickling takes place on frames of wood, iron or acidproof bronze. The capacity of a frame runs to 5,500 lbs. of wire of 3/16 inch diameter, with coil weights of 165 to 175 pounds. In a pickling vat two frames of wire can be pickled together. On the bottom of the vat two or three pieces of 6″ x 8″ beechwood are placed on which the frames rest. Steinmüller discusses the disadvantages of this in his "Draht-Welt-Buch". Acid baths of wood are lined with acid resisting tile and mortar. The size varies. The washing bath is an important part of the unit, because the greatest part of the acid and iron must be completely washed from the wire.

Economic Considerations Must Govern

In the practical carrying out of wire pickling one will be actuated by expediency. Whether it is a question of pickling immediately upon receipt of the wire or whether one intends to store it, in both cases economic points of view govern. Transport costs, storing costs and the required arrangements for longer storage play a most important role. Even the necessary rack park is related to costs.

★ ★ ★

Finally it should be remarked that research is not standing still and consequently many new features may be introduced, both respecting the pickling process itself and the requisite equipment.

The Organization and Application of Plant Maintenance in a Wire Works

(*Continued from page* 1485)

The feeding and distribution is largely conventional. The heavy individual galvanising plants do however necessitate a lot of additional H.T. and L.T. switch gear.

★ ★ ★

In a works that has expanded rapidly in the last twenty years, the distribution does become rather involved, the ideal being roomy and well ventilated substations with good accessibility to switchgear and transformers and first class electrical equipment to go in them.

★ ★ ★

Gas. Here again the high price of gas is a large cost item. Lead pots, galvanising and tinning furnaces are the chief users.

★ ★ ★

Burners are regularly checked and cleaned, likewise gas control equipment. This is particularly important for galvanising furnaces where the temperature of the zinc is critical.

★ ★ ★

Water. Due to the poor quality of the trade water supply, a lot of maintenance is required on mains, valves etc. A pipe fitter in each maintenance zone is employed for this purpose.

★ ★ ★

As mentioned in the paragraph on corrosion, fume scrubbing is assuming considerable importance, in addition the rivers pollution act when enforced will mean greater dilution of noxious effluents.

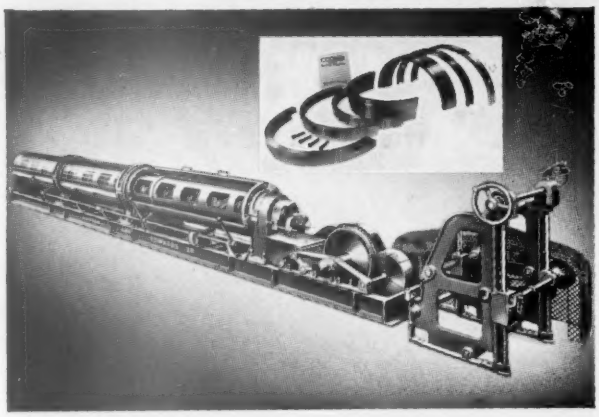
★ ★ ★

Hence a good supply of cheap water is essential and should be ensured for any wiredrawing plant extensions.

★ ★ ★

Steam. The majority of steam is used for space heating with about 25% for cleaning processes. There are no special problems apart from those involved in conventional steam practice.

ROLLER BEARING TUBULAR STRANDING MACHINE



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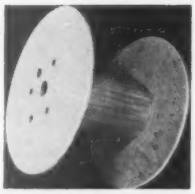

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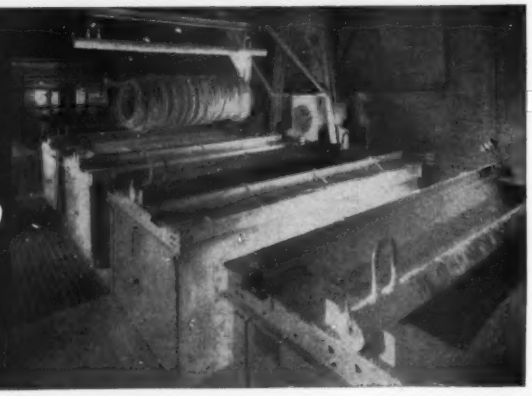

Faster baking, greater fuel economy, maximum production efficiency are just a few of the results of the exclusive heating arrangement of the Carl Mayer Hi-Speed Rod Baker. It also has a patented blow-off feature which removes moisture without damage to coils.

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Fuel Economy

Besides the national need for fuel economy, in production any savings in fuel will be directly reflected in the cost of the production.

★ ★ ★

The main items where saving can be made are:

(a) Insulating of all galvanising and lead baths.
(b) Insulating of lime and borax tanks.
(c) Insulating of all steam mains.
(d) Insulating of roofs to conserve space heating.
(e) Efficiency in the boiler house.

Safety

Safety is closely tied to maintenance and it is the definite responsibility of the maintenance department to see that all plant is adequately guarded and that all electrical equipment is safe. The aim is to be one jump ahead of the factory inspector.

★ ★ ★

All new plant and machinery must be thoroughly vetted for safe working before handing over to production. As mentioned previously, planned maintenance has a big part to play in ensuring that all safety devices are regularly checked.

Inspection of Boilers and Lifting Tackle

A tight system must cover these two points. In both cases a qualified insurance company surveyor is employed on contract and has given excellent service, assistance and co-operation.

★ ★ ★

(a) Boiler Inspection. This is clearly laid down in the Factory Act. A fairly simple office system is required to register all test certificates and reports.
(b) Lifting Tackle. As stated above, there are no less than 125 cranes and 24 ram trucks. All these require inspection and certification every six months by a qualified person.

★ ★ ★

The office system involved is briefly this:

(1) Filing system for all reports and test certificates.
(2) General Register for all plant concerned.

for extra tonnage
from your bar stock
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coat with
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5 MOL.

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(3) Repair note for all necessary repairs to ensure that they are carried out and logged when done.

The Cost

Maintenance Costs. As mentioned in the introduction, the cost of maintenance is an extremely important factor. It would be an easy matter, provided labour was available, to flood the works with engineering labour and hence ensure high efficiency and an easy time for everybody. The problem however is to obtain high plant efficiency with the minimum labour. This is where the establishments referred to earlier are so very important.

★ ★ ★

Cost figures must be readily available and to enable the Cost Department to provide these, there must be a system whereby all the material and labour charges are correctly channelled.

★ ★ ★

Each man fills in a sheet weekly covering the time he has spent in the various departments. From these sheets labour charges to each department are extracted. This is of course primarily for the necessary departmental accounting. It is however essential that these figures are available to engineering supervision. The Cost Departments can produce very useful statistics as follows:

(a) Percentage of maintenance wages to production wages.
(b) Cost of maintenance per ton overall.
(c) Cost of maintenance per ton for individual products.
(d) Cost of maintenance in pounds per 1,000 hours production.

★ ★ ★

If these figures are plotted graphically a clear picture of maintenance costs can be obtained and rising costs checked in time.

★ ★ ★

Material Costs. This is largely tied to good storekeeping and intelligent use of spares and materials.

★ ★ ★

Labour. In conclusion it is obvious that whatever organisation is

MOLDED FLANGE
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Sizes: 6" to 12" Dia. Flange. Flange sizes with any barrel diameter are available . . . . . Non-Loosening Bolt Assembly. For: Wire Hose, Magnet Wire, Welding Wire, Etc.
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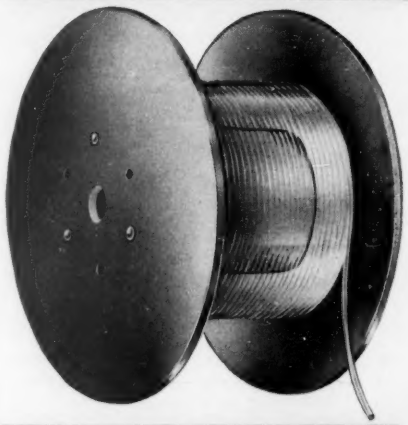

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- Durable — Inexpensive.
- Initial cost lower.
- Weight about 1/5th that of steel.
- Low freight charges for tare weight.
- No bookkeeping costs.
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- Tubes recessed into flange and firmly cemented into place.
- Customer's name or Trade-Mark can be molded into the flange, at no extra cost.

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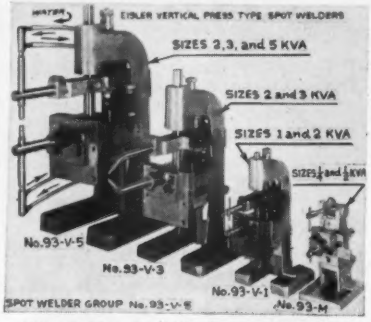
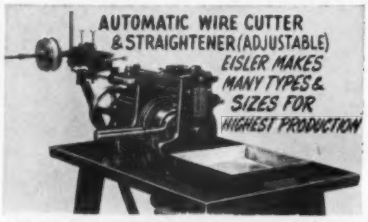


Wire Cutting-Straightening and Forming Machines for All Types of Wire



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involved, in the end it depends on the type of labour employed.

★ ★ ★

A high standard is necessary in all trades, in particular those tradesmen who are on shift maintenance and consequently have to cover the plant on a night turn when engineering supervision is not in the works.

★ ★ ★

There is no doubt that at the moment of writing this presents a serious problem. The older tradesmen are fast retiring—by older, meaning those who have grown up with the plant over say thirty years—those we are fortunate still to retain are invaluable.

★ ★ ★

Due to the depression of the thirties and then the war, we are now suffering from an inadequate supply of tradesmen in the age group 30-40. To meet this and also to provide for the future, an Apprentice Training School was started in 1950, ten apprentices—electrical, mechanical and machinist—being taken on each year and placed under the control of a qualified apprentice supervisor. After an initial year in the school they are then progressively moved around the shops until at 21 they can emerge as first class tradesmen.

★ ★ ★

Considerable emphasis is placed on technical education and this is assisted by extra coaching in works time and, of course, day release to technical schools.

★ ★ ★

It is hoped that this system will provide, in the not too distant future, a skillful team of tradesmen and, indeed, the necessary supervision to go with it.

Conclusion

The object of this paper has been briefly to cover all the angles of maintenance encountered, with particular emphasis on certain points. Some angles alone, such as planned maintenance, deserve a paper on their own.

★ ★ ★

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Extends to all persons in the Wire Industry—our readers, our authors and our advertisers—
Cordial Good Wishes
for a
Merry Christmas
and a
Happy and Prosperous
New Year
May the coming year be a fine one for you all.

The main conclusions are however:

(a) Application of planned maintenance system wherever possible.

(b) Tight control on engineering establishments of personnel.

(c) A well organised spares system with machining facilities to back it up.

(d) Use of modern processes and materials.

(e) Cost conscious attitude.

(f) Training of craftsmen for the future.

★ ★ ★

Automation is no doubt the thing of the future and in fact has already been with us for some time. The automatic factory however will require maintaining and an engineering department will always be an essential section of a Wire Works and the above six principles still apply.

West Coast Representative Named by Gem Gravure

The appointment of the **Paul I. Kenner Co.,** 230 Shaw Road, South San Francisco, Calif., to represent **Gem Gravure Company** on the West Coast has been announced by **Joseph C. Gemelli,** President.

★ ★ ★

Gem Gravure manufactures printing wheels, printing machines, and inks for marking electric wire and cable. Arrangements have been made to stock this equipment and the inks in Mr. Kenner's warehouse to provide prompt service to Western customers. All inquiries from west of the Mississippi, including British Columbia and Mexico, may be sent to Paul I. Kenner at the address above.

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In order to provide additional accommodation for their sales and technical staff, the Sales Office of **Larmuth & Bulmer Limited** has moved to 58 Whitworth Street, Manchester, 1, England.

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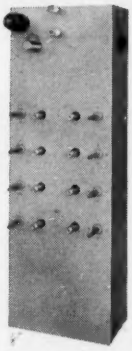

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Music Wire for Industrial Purposes

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Aluminum—Annealed—Belt Lacing—Brass, Soft and Spring—Copper, Bare and Tinned Coppered Steel Spring—Galvanized—Tinned

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Open hearth grades from low metalloid through high carbon, Thomas grades, cold heading and special grades for sensitive applications. Heavy coils up to 880 lbs.—I.D. up to 33½". Sizes down to .20".

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Experimental Prestressed Concrete Highway— An Engineering Report

(*Continued from page* 1474)

promotional work on prestressed concrete highways. We have received excellent cooperation from the Highway Research Board and the research engineers of the Bureau of Public Roads. It is anticipated that traffic test strips in several states will become a reality in 1959.

★ ★ ★

We consider this experiment was successful in attaining its objectives of proving structural adequacy, demonstrating practicability and solving the expansion joint problem. In respect to economy, a conventional highway pavement in Northwestern Pennsylvania would involve a total cost of $6.50/sq. yd. The comparable costs using a prestressed unit of 600 feet would be $6.55, which is competitive with the conventional construction. Increasing the unit length to 800 ft. would reduce the cost to $6.27, while decreasing the length to the 400 ft. used in the experiment would increase the cost to $6.98. The results of this experiment have indicated that the longer lengths are practical. These data, we would say, confirm the economy of the method.

★ ★ ★

We would like to summarize the construction which would be recommended for a full scale highway pavement, based on the experience and knowledge gained from this experiment:

1. **The pavement would be 24 ft. wide x 5 in. thick x at least 600 ft. long. (Lengths up to 800 ft. are feasible.)**
2. **Tendons would consist of high strength, stress-relieved wire, rather than strand because of a more favorable price. The amount of wire needed would be of the order of 5.25#/sq. yd. (18.5 tons/lane mile).**
3. **The basic gap jacking technique would be used, modified to an "above the pavement" operation.**
4. **Expansion joints, similar to those utilized in the experiment would be used.**

★ ★ ★

The next phase of this development, gentlemen, must lie in the

hands of the state highway departments. We believe sufficient data have been developed by this experiment to justify the construction of test strips of two miles or more in several states strategically located to test a variety of climatic and traffic load conditions. These strips are needed to provide the final proof of the adequacy, the advantages and the economics of prestressed concrete highway pavements.

Fabrication and Properties of 5005 Aluminum Alloy Cables for Overhead Power Lines

(*Continued from page* 1480)

the neutral messenger for multiplex service drop cables. Physical characteristics of the various multiplex constructions with 5005 messengers are shown in Tables 9 through 14.

Description

The various aluminum alloys, with the exception of EC, are identified throughout the aluminum industry by a uniform system of numbers. The industry-recognized designation number of 5005 is, therefore, used to identify conductors made of 5005 alloy.

* * *

As an aid to identifying individual constructions of cables, a dual code word system was devised for those using 5005. The first code word identifies the particular size of 5005 cable, and the second indicates whether it is bare, covered or is used as a bare neutral messenger in multiplex construction. For example:

"Kaki-Bare" is AWG #4 EC equivalent size, and it is bare.
"Kaki-Neo." is the same as "Kaki-Bare" except it is covered with neoprene.
"Kaki-Shark" is the same as neoprene triplex "Shark" except that the 5005 cable "Kaki" is used for the bare neutral messenger instead of No. 4 ACSR.

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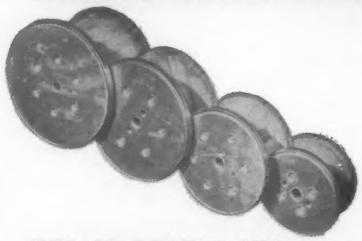
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The Performance of Vinyl Insulation Rated for 75° C THW Service

(*Continued from page* 1471)

recent production samples tested in a third laboratory. Data for 3/64 inch wall are included in this plot.

★ ★ ★

You will note that with the exception of the one insulation resistance curve on the last graph all data were obtained on 1/32 inch wall of insulation for #14 AWG. The considered opinion of some industry experts and advisory groups is that a standard for THW should establish a minimum 3/64 inch wall for sizes #14 and #12 AWG to insure maximum safety performance.

★ ★ ★

We set our goal two years ago to provide an insulation that would meet the requirements with a good margin of safety based on the accepted 60° C TW insulation thickness. Certainly if a standard is established for 75° C THW requiring the 3/64 inch minimum, the performance data presented in this discussion indicate that this vinyl insulation will provide the high quality performance required.

★ ★ ★

In summary, a twenty year service history has proved the good performance of vinyl insulation. In particular, 60° C TW building wire gained unlimited acceptance during the past fifteen years by virtue of quality standards originally established. The proposed compound has been proved by commercial performance under certain critical specifications. Furthermore, it displays better properties at rated temperature, in the light of anticipated 75° C THW service, than the accepted standards for 60° C TW at its rated temperature. In addition, the facts prove "all around" performance characteristics at least equivalent to the accepted 75° C RHW.

★ ★ ★

Acceptance of 75° C THW in the National Electric Code should be achieved and the high quality standards for performance at this

A Hearty Wish for a
Merry Christmas
and a
Prosperous New Year
is extended to our many
Customers and Friends
in the
Wire Industry

We are grateful to you for your confidence and patronage during the past year and shall try to justify it through even better service in 1959.

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DESIGNED FOR LONG LIFE AND MAXIMUM WIRE PRODUCTION
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ALSO, A FULL LINE OF CARBIDE TOOLING FOR THE COLD HEADING INDUSTRY
EASTERN CARBIDE CORP.
NEW ROCHELLE, N. Y.

rating should be established on the basis of the facts presented.

Data from U/L Fact-Finding Investigation of Geon 8800 for Type THW—All Tests on #14 AWG With 1/32 Inch Wall

Accelerated Aging

Percent of original elongation:

After 60 Days at 82°C	99
After 7 Days at 100°C	100
After 10 Days at 100°C	100
After 7 Days at 121°C	99
After 10 Days at 121°C	98

Conductor Corrosion

There was no evidence of conductor corrosion or discoloration after wire samples were subjected to accelerated aging tests noted above.

Aged Flexibility

There was no checking or cracking of the insulation of wire samples wound around a .313" mandrel after aging 60 days at 82° C.

Dielectric Decline

Percent decline in dielectric strength after immersion 14 days in water.

At 70°C	0
At 85°C	5

Specific Inductive Capacitance

At 30°C 1000 cps:

After 1 Day	5.42
Per Cent Change, 1st to 14th Day	3.95
Per Cent Change, 7th to 14th Day	1.17

At 75°C and 1000 Cps:

After 1 Day	8.15
Per Cent Change, 1st to 14th Day	1.34
Per Cent Change, 7th to 14th Day	0.61
Per Cent Change, 14th to 28th Day	0.55

INSULATION RESISTANCE (MEGOHMS PER 1000 FT.)

	Black	Natural	Red	Green
After 1 Hour at 15.6°C	13400	21900	5850	8600
After 24 Hours at 75°C	3.82	2.30	1.37	0.92
After 1 Week at 75°C	3.81	2.10	1.42	1.40
After 10 Weeks at 75°C	1.43	0.87	0.79	0.95
After 20 Weeks at 75°C	0.84	0.64	0.65	0.75
After 30 Weeks at 75°C	0.40	0.42	0.53	0.59
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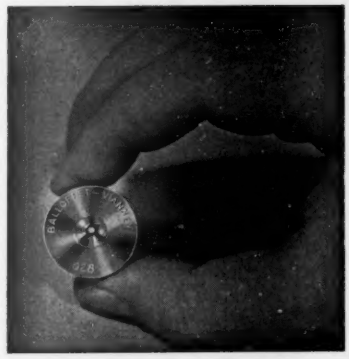
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Deformation

A. Ratio of T_2 to T_1:

After 1 Hour at 121°C under 500 Gram Load 0.84

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After 1 Hour 0.73

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B. Flow Test Over Conduit Bushings After 20 Days at 75°C:

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Crush

Pounds required to ground conductor at room temperature 2060

* Limit of test transformer.

** This test was not performed in the Underwriters' Laboratories fact-finding investigation.

J. L. Clark Man Heads Metal Decorators Group

Harold W. Lee, director of lithography at **J. L. Clark Manufacturing Co.,** 2300 Sixth St., Rockford, Ill., was named president of the National Metal Decorators' Association at the group's 1958 convention in Washington, D. C.

* * *

Mr. Lee has previously served as secretary and vice president of the association, which he will now head for two years. He has been lithographing director at J. L. Clark, producer of metal containers and wire reels since 1949.

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Tests to Evaluate the Lightning Behavior of Telephone Wire and Cable Insulation

(*Continued from page* 1473)

plant situation. A good economic balance between the cost of protection and the benefits derived will not be achieved unless considerations are based on dielectric values representative of the major portion of the plant involved rather than on those of a few lower dielectric points. The surge breakdown relationships secured under the similar test conditions in this study have provided a better means of evaluating the lightning protection requirements for plant employing the plastic insulations than was previously possible from the factory test values. This was achieved by relating the behavior of the test specimens to lightning field experience secured over a period of years with pulp and paper strip insulation.

REFERENCES

(1) Dielectric Strength and Voltage Life of Polyethylene by G. H. Hunt, M. J. Koulopoulos and P. H. Ware; AIEE Transactions Paper 58-51, February 1958.

(2) High Voltage D-C Testing of Rubber Insulated Wire by W. N. Eddy & W. D. Fenn; Electrical Engineering 1946, Vol. 65. (Although this paper deals principally with rubber insulation, it briefly presents data on the breakdown relationships of solid polyethylene insulation on wire.)

(3) Intrinsic Strength of Polyethylene and Its Variation with Temperature W. G. Oakes—Journal of E. E. U 95-1948.

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Amchem Products, Inc., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

COMPOUNDS—Phosphate Coating
Amchem Products, Inc., Ambler, Pa.

COMPOUNDS—Rust Preventing
Amchem Products, Inc., Ambler, Pa.
American Lanolin Corporation, Lawrence, Mass.
Apex Alkali Products Co., Philadelphia, Pa.

COMPOUNDS—Rust Removing
Amchem Products, Inc., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N.Y.
Nopco Chemical Co., Harrison, N. J.
Standard Industrial Compounds Co., Frankfort, Ill.

COMPOUNDS—Vinyl
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
Chemical Products Corporation, East Providence, R. I.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Magnuson Products Corporation, Brooklyn, N.Y.
Miller, R. H. Co., Inc., Homer, N. Y.
Nopco Chemical Co., Harrison, N. J.
Standard Industrial Compounds Co., Frankfort, Ill.
Swift & Company, Chicago, Ill.
United States Borax & Chemical Corp., Pacific Coast Borax Co. Div., New York, N. Y.

CONDUCTORS—Flexible, Electrical
Montgomery Co., The, Windsor Locks, Conn.

CONTAINERS—Wire Packaging
(See DRUMS—Wire Packaging)

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

CORDS—Electrical, Tinsel Conductor
Montgomery Co., The, Windsor Locks, Conn.

COUNTERS—
(See MACHINERY—Measuring Wire and Cable)

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Metal Carbides Corporation, Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Detroit

CUTTING TOOLS—Wire
Robinson, M. W. Co., Rockfall, Conn.

DIAMONDS—Industrial
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDERS—
Danforth, The C. W. Co., Youngstown, Ohio
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Hyprez Div., Engis Equipment Co., Chicago, Ill.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Research Company, St. Clair Shores, Mich.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Hillside, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDER RECLAIMING—
Danforth, The C. W. Co., Youngstown, Ohio
Elgin National Watch Co., Abrasives Div., Elgin, Ill.
Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Research Co., St. Clair Shores, Mich.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

DIAMOND TOOLS—
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio
Universal Wire Die Co., Hillside, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIES—Carbide, Tungsten & Tantalum
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Metallurgical Products Dept. of General Electric Co., Detroit
Rusch Wire Die Corp., Croton-on-Hudson, N. Y
Universal Wire Die Co., Hillside, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIES—Cold Heading
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Detroit.

DIES—Diamond
Ajax Industrial Supplies, Inc., Ft. Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Brenon, Inc., Nixon, N. J.
Ft. Wayne Wire Die Inc., Fort Wayne, Ind.
Hoosier Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
National Wire Die Co., Inc., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Roux Wire Die Works, Inc., Oriskany, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Hillside, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIES DIAMOND—Drawing Angle Controlled
Hoosier Wire Die, Inc., Ft. Wayne, Ind.

DIES DIAMOND—Reversible
Indiana Wire Die Company, Fort Wayne, Indiana
National Wire Die Co., Inc., New York, N. Y.

DIES—Extrusion
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Kelloy Corporation, New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Detroit
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Hillside, N. J.
Wayne Wire Die Co., Hillside, N. J.
Wire Tool Div., Bridgeport Jig Boring Co., Bridgeport, Conn.

DIES—Eyelet
Eastern Carbide Corp., New Rochelle, N. Y.
Kelloy Corporation, New York, N. Y.

DIES—Nail, Nail Cutters, Feeder Blocks, Grippers, etc.
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa

DIES—Pointing
Sjogren Tool and Machine Co., Auburn, Mass

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., Inc., New York, N. Y.
Brenon, Inc., Nixon, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.

Hoosier Wire Die, Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio
Metallurgical Products Dept. of General Electric Co., Detroit
National Wire Die Co., Inc., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
Roux Wire Die Works, Inc., Oriskany, N. Y.
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.
Universal Wire Die Co., Hillside, N. J.
Wayne Wire Die Co., Hillside, N. J.

DIES—Special Shapes, Etc.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelloy Corporation, New York, N. Y.

DIES—Swaging
Sjogren Tool and Mach. Co., Inc., Auburn, Mass.

DIES—Tinning
Roux Wire Die Works, Inc., Oriskany, N. Y.

DIES—Tube Drawing
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth Sterling, Inc., Pittsburgh, Pa.
Hoosier Wire Die., Inc., Ft. Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelloy Corporation, New York, N. Y.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Metallurgical Products Dept. of General Electric Co., Detroit
Rusch Wire Die Corp., Croton-on-Hudson, N. Y.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRIVES—Electric, Adjustable Speed
Allis, The Louis Co., Milwaukee, Wisc.

DRUMS—Wire Packaging
Continental Can Company, Van Wert, Ohio
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Seymour & Peck Div., The Greif Bros. Cooperage Corp., Chicago, Ill.

DRUMS & TRAVERSES—For Cable Reels
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio

DRYING EQUIPMENT—
Carl Mayer Corp., The, Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FOAM PRODUCING COMPOUNDS—
Amchem Products, Inc., Ambler, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

FREQUENCY CHANGERS—
The Louis Allis Company, Milwaukee, Wisc.

FURNACES—Brazing
Ajax Electric Company, Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Ill.

FURNACES—Galvanizing Equipment
Electric Furnace Co., Salem, Ohio
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Ill.
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Heat Treating
Ajax Electric Company, Philadelphia, Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Ill.
Wilson, Lee, Engr. Co., Cleveland, Ohio

FURNACES—Pot (Oil, Gas, Electric)
Ajax Electric Company, Philadelphia, Pa.
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Ill.

FURNACES—Resistance Heating, Strand
Electric Furnace Company, Salem, Ohio
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Ill.

FURNACES—Salt Bath
Ajax Electric Company, Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio

FURNACES—Strand Annealing
Ajax Electric Company, Philadelphia, Pa.
Electric Furnace Company, Salem, Ohio
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)
Sunbeam Corporation, (Industrial Furnace Division), Chicago, Ill.

GALVANIZING EQUIPMENT—(See MACHINERY—Galvanizing Wire)

GEARMOTORS—
The Louis Allis Company, Milwaukee, Wisc.

GRINDERS—Roll
Norton Co., The, Worcester, Mass.

GUIDES—For Wire
Heany Industrial Ceramic Corp., New Haven, Conn.

GUIDE TIPS—For Extruding Machines (See NOZZLES)

HAMMERS—Nail Heading
Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio

INHIBITORS—Pickling
Amchem Products, Inc., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Parkin Chemical Co., The, Pittsburgh, Pa.

INKS—Printing, for Insulated Wire
Chemical Products Corporation, East Providence, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.

INSULATING MATERIALS —
Apex Tire & Rubber Co., Pawtucket, R. I.
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
duPont de Nemours Co., (Inc.), E. I., Polychemical Dept., Wilmington, Delaware
General Electric Company, Insulating Materials Section, Schenectady, N. Y.
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Plymouth Cordage Company, Plymkraft Division, Plymouth, Mass.
Shawinigan Resins Corporation, Springfield, Mass.
Thompson Chemical Company, Pawtucket, R. I.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

LACQUERING SYSTEMS—See MACH.—Lacquering Electric Wire

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LIME—
Warner Co., The, Philadelphia and Bellefonte, Pa.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Miller, R. H., Co., Inc., Homer, N. Y.
Nopco Chemical Company, Harrison, N. J.
Standard Industrial Compounds Co., Frankfort, Ill.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.

MACHINERY—Armoring (Cable, Wire, Hose)
American Insulating Mach'y Co., Phila., Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc., (used), Pawtucket, R. I.

MACHINERY—Barbed Wire
Glader Wm., Machine Works, Chicago, Ill.

MACHINERY—Bobbin Winders
Hanson & Edwards, Ltd., Warrington, England
Larmuth and Bulmer, Limited, Manchester, England

MACHINERY—Bolt, Rivet, Screw, etc.
Behr Machinery & Equipment Corp., Rockford, Ill.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Braiding
New England Butt Co., Providence, R. I., Division of Wanskuck Co.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bunching
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Bundling, Scrap
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Capstans (See Capstans and Machinery—Winding Wire)

MACHINERY—Centerless Grinding & Polishing
American Laubscher Corporation, New York, N. Y.

MACHINERY—Chain Link Fence
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Steel & Wire Machinery Co., Cleveland, Ohio

MACHINERY—Chain Making
Baird Machine Company, Stratford, Conn.
Larmuth and Bulmer, Limited, Manchester, England
Nilson, A. H. Machine Co., Shelton, Conn.
Steel & Wire Machinery Co., Cleveland, Ohio

MACHINERY—Closing Rope
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
Niehaus, K. A., Maschinenfabrik, Dusseldorf-Rath, Germany
Watson Machine Co., Paterson, N. J.

MACHINERY—Coiling Rod
Vaughn Mach'y Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Cold Heading
Behr Machinery & Equipment Corp., Rockford, Ill.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Copper Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
Cook Mfg. Co., The, Paterson, N. J.
Herborn, Maschinenfabrik, Herborn, Germany
Morgardshammars Mek Verkstads A. B., Morgardshammar, Sweden.
National Mach'y Exch (Used), New York
Steel & Wire Machinery Co., Cleveland, Ohio
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Covering Wire (See MACHINERY—Insulating Wire)

MACHINERY—Cutting
Eisler Engineering Company, Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Dead Block (Stationary Coiler)
Morgan Construction Company, Worcester, Mass.
Wells Company, Frank L., Kenosha, Wisc.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Descaling Rod, Dry
Fisher Associates, New York, N. Y.
Herborn, Maschinenfabrik, Herborn, Germany
Wheelabrator Corporation, Mishawaka, Indiana

MACHINERY—Die Making
Boulin, Victor J., Inc., New York, N. Y.
Dykrex Corp., Roos Tool & Mfg. Div., Newark, N. J.
Firth Sterling, Inc., Pittsburgh, Pa.
Metallurgical Products Dept. of General Electric Co., Detroit
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Morgan Construction Co., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Edging (See MACHINERY — Tandem Rolling and Edging Mills)

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Davis Electric Co., Wallingford, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

MACHINERY—Extruding
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Royle, John, & Sons, Paterson, N. J.

Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.
Norton & Co., Ltd., Sir James Farmer, Manchester, England

MACHINERY—Flat Wire
Mettler Machine Tool, Inc., New Haven, Conn.
Steel Equipment Company, Cleveland, Ohio
Steel & Wire Machinery Co., Cleveland, Ohio
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Forming Wire
Baird Machine Company, Stratford, Conn.
Nilson, A. H. Machine Co., Shelton, Conn.
Steel & Wire Machinery Co., Cleveland, Ohio

MACHINERY—Galvanizing Wire
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)
Steel & Wire Machinery Co., Cleveland, Ohio
Vaughn Machinery Co., Cuyahoga Falls, O.
Whitacre Engineering & Manufacturing Company, Alhambra, California
Wilson, Lee, Engr. Co., Cleveland, Ohio

MACHINERY—Gang Winders
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Mfg. Co., Wallingford, Conn.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating Wire
American Insulating Mach'y Co., Phila., Pa.
Beard Machine Co., York, Pa.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lacquering Electric Wire
American Insulating Mach'y Co., Philadelphia
Cook Mfg. Co., The, Paterson, N. J.
Michigan Oven Company, Detroit, Mich.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Material Handling
(See Material Handling Equipment)

MACHINERY—Measuring Wire & Cable
Davis Electric Co., Wallingford, Conn.
Entwistle, James L., Esmond, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N. Y.

MACHINERY—Packaging Wire
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Patenting Wire
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Plating
Bartell Machine Tool Corp., Rome, N. Y.
Hodge Bros. Machine Shop, Ossining, N. Y.
Universal Industrial Equipment Co., Secaucus, N. J.

MACHINERY—Pointing
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York,
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Printing on Electric Wire
Entwistle, James L., Esmond, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M. Co., Inc., Boylston, Mass.

MACHINERY—Re-Spooling
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Emory Company, Robert J., Newark, N. J.
Entwistle, James L., Esmond, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
National Mach'y Exch. (Used), New York N. Y.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

MACHINERY—Rod Mill
Herborn, Maschinenfabrik, Herborn, Germany
Morgan Construction Co., Worcester, Mass.

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Rubber Insulating
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Royle, John & Sons, Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Serving
Pourtier Pere et Fils, Romainville (Seine), France
Wardwell Braiding Machine Co., Central Falls, R. I.

MACHINERY—Slitting Mills
Steel Equipment Company, Cleveland, Ohio

MACHINERY—Spark Testing
Davis Electric Co., Wallingford, Conn.
Entwistle, James L., Esmond, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Spooling Tension Controls
Web Controls Corp., West Englewood, N. J.

MACHINERY—Spring Making
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wells Company, Frank L., Kenosha, Wisc.

MACHINERY—Staple
Baird Machine Company, Stratford, Conn.
Nilson, A. H. Machine Co., Shelton, Conn.

MACHINERY—Straightening & Cutting
American Laubscher Corporation, New York 19, N. Y.
Lewis Machine Co., The, Cleveland, Ohio
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel & Wire Machinery Co., Cleveland, Ohio
Wells Company, Frank L., Kenosha, Wisc.

MACHINERY—Stranding
Bartell Machine Tool Corp., Rome, N. Y.
Hanson & Edwards, Ltd., Warrington, England
Haskell-Dawes Machine Co., Philadelphia, Pa.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth & Bulmer Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Niehaus, K. A., Maschinenfabrik, Düsseldorf-Rath, Germany
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Swaging
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Take-Up and Pay-Out
American Insulating Mach'y Co., Phila., Pa.
Bartell Machine Tool Corp., Rome, N. Y.
Colbourne Machine Company, Winsted, Conn.
Collins Bros. Machine Co., Wire & Cable Machy. Div., Pawtucket, R. I.
Davis Electric Co., Wallingford, Conn.
Davis-Standard Division of Franklin Research Corporation, Mystic, Conn.
Entwistle, James L., Esmond, R. I.
Entwistle Manufacturing Corporation, Providence, R. I.
Federal Manufacturing Company, Wallingford, Conn.
General Engineering Company (Radcliffe) Limited, Radcliffe, England
Kraft, J. A., Maschinenfabrik, OLPE/Westf. Germany
Larmuth & Bulmer Limited, Manchester, England
Litzler, C. A., Co., Inc., Cleveland, Ohio
Northern Indiana Steel Supply Co., Inc., Michigan City, Indiana
Pourtier Pere et Fils, Romainville (Seine) France
Standard Mill Supply Co., Pawtucket, R. I.
Steel Equipment Company, Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Collins Bros. Machine Co., Wire & Cable Machy. Div., Pawtucket, R. I.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Pourtier Pere et Fils, Romainville (Seine), France
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

MACHINERY—Testing Magnet Wire Coatings for Pin Holes
Federal Mfg. Co., Wallingford, Conn.

MACHINERY—Testing, Physical
Scott Testers, Inc., Providence, R. I.

MACHINERY—Thread Rolling
Mettler Machine Tool, Inc., New Haven, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
Cook Manufacturing Co., The, Paterson, N. J.
Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)
Syncro Machine Co., Perth Amboy, N. J.
Universal Industrial Equipment Co., Secaucus, N. J.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill, Cold Drawing
Mettler Machine Tool, Inc., New Haven, Conn.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Twisters, Wire
Cook Manufacturing Co., The, Paterson, N. J.
Edmands Company, The, Cranston, R. I.
Haskell-Dawes Machine Co., Philadelphia, Pa.

MACHINERY—Used
National Machinery Exchange, New York, N. Y.
Wire & Textile Machy., Inc., Pawtucket, R. I.

MACHINERY—Welded Wire Mesh
National Electric Welding Machines Co., Bay City, Michigan
Schlatter, Ltd., H. A., Zollikon/Zurich

MACHINERY—for Wire Welding
(See WELDERS—Butt and Spot and Machinery —Welding Wire Fabrics)

MACHINERY—Winding Wire
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Entwistle, James L., Esmond, R. I.
Federal Manufacturing Company, Wallingford, Conn.
Kraft, J. A., Maschinenfabrik, OLPE/Westf., Germany
Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I
Steel Equipment Company, Cleveland, Ohio
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Laubscher Corporation, New York 19, N. Y.

Cook Manufacturing Co., The, Paterson, N. J.
Coulter & McKenzie Machine Co., Bridgeport, Conn.
Federal Mfg. Co., Wallingford, Conn.
Herborn, Maschinenfabrik, Herborn, Germany
Hodge Bros. Machine Shop, Ossining, N. Y.
Morgan Construction Co., Worcester, Mass.
Morgardshammars Mek Verkstads AB, Morgardshammar, Sweden
National Mach'y Exch. (Used), New York, N. Y.
Norton & Co., Ltd., Sir James Farmer, Manchester, England
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Wire and Machinery Co., Cleveland, Ohio
Superior Tool & Manufacturing Company, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wartenweiler, Emilio, Milan, Italy
Waterbury-Farrel Fdry. & Mach. Co., Division of Textron Inc., Waterbury, Conn.
Whitacre Engineering & Manufacturing Company, Alhambra, California

MACHINERY—Wire Forming

Baird Machine Company, Stratford, Conn.
National Mach'y Exch. (Used), New York, N. Y.
Nilson, A. H. Machine Co., Shelton, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Wire Rope

Larmuth and Bulmer, Limited, Manchester, England
New England Butt Co., Division Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wrapping with Paper

Larmuth (1947) Ltd., Swinton, England
Terkelsen Machine Company, Boston, Mass.

MATERIAL HANDLING EQUIPMENT—

Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MOTORS—Electric, A.C. — D.C.

The Louis Allis Company, Milwaukee, Wisc.

NAIL TOOLING—Tungsten Carbide

Firth Sterling, Inc., Pittsburgh, Pa.
Pittsburgh Carbide Die Co., Monongahela, Pa.

NAILS—Wire

Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
Wickwire Brothers, Inc., Cortland, N. Y.

NIPPERS—Wire Cutting

Robinson, M. W. Co., Rockfall, Conn.

NOZZLES—For Extruding Machines

Wire Tool Div., Bridgeport Jig Boring Co., Bridgeport, Conn.

OVENS—Cable Lacquering and Enameling

American Insulating Mach'y Co., Phila., Pa.
Carl Mayer Corp., The, Cleveland, Ohio
Colbourne Machine Company, Winsted, Conn.
Litzler, C. A., Co., Inc., Cleveland, Ohio
Michigan Oven Company, Detroit, Mich.

OVENS—Rod Bakers

Carl Mayer Corp., The, Cleveland, Ohio

OVENS—Welding Rod Coating

Carl Mayer Corp., The, Cleveland, Ohio
Litzler, C. A., Co., Inc., Cleveland, Ohio

PAILS—Packaging

(See Drums—Wire Packaging)

PAINT BONDING CHEMICALS—

Amchem Products, Inc., Ambler, Pa.

PAINTS—Heat Resisting

Amchem Products, Inc., Ambler, Pa.

PAPER—Creped Wrapping

Ludlow Papers, Inc., Needham Heights, Mass.

PAPER—For Coil Wrapping and Corrosion Prevention

Ludlow Papers, Inc., Needham Heights, Mass.

PAPER—Insulating

Ludlow Papers, Inc., Needham Heights, Mass.
Twitchell, Inc., E. W., Philadelphia, Pa.

PATENT—ATTORNEYS—

Rommel, Allwine & Rommel, Washington, D. C.

PAY-OUT SYSTEMS—

(See MACHINERY—Take-Up & Pay-Out)

PHOSPHATE COATING CHEMICALS

(See COMPOUNDS—Phosphate Coating)

PICKLING COMPOUNDS—

See (Inhibitors—Pickling)

PLASTICIZERS—

Cary Chemicals, Inc., New Brunswick, N. J.
Monsanto Chemical Company, Plastics Division, St. Louis, Mo.

PLASTICS—for Wire Insulation

Apex Tire & Rubber Co., Pawtucket, R. I.
Blane Corporation, The, Canton, Mass.
Cary Chemicals, Inc., New Brunswick, N. J.
duPont de Nemours Co., (Inc.), E. I., Polychemical Dept., Wilmington, Delaware
Monsanto Chemical Company, Plastics Division, Springfield, Mass.
Shawinigan Resins Corporation, Springfield, Mass.
Thompson Chemical Company, Pawtucket, R. I.
U. S. Industrial Chemicals Company, Division of National Distillers & Chemical Corporation, New York, N. Y.
United States Rubber Company, Naugatuck Chemical Division, New York, N. Y.

PRINTING WHEELS—for Electric Wire

Frank Daniels & Co., New York, N. Y.
Entwistle Manufacturing Corporation, Providence, R. I.
Gem Gravure Co., Inc., West Hanover, Mass.
Gillies, Duncan M. Co. Inc., Boylston, Mass.

PULLERS AND GRIPS—For Wire

Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry. & Mach. Co., Trenton, N. J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

RACKS—Wire Storage

Jarke Manufacturing Co., Chicago, Illinois

REEL AND TENSION STANDS—

Mettler Machine Tool, Inc., New Haven, Conn.
Northern Indiana Steel Supply Co., Inc., Michigan City, Indiana
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply Co., Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—

Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Aluminum Alloy

Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
National Vulcanized Fibre Co., Lestershire Spool Div., Johnson City, N. Y.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Annealing and Stranding

Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio

REELS—Metal Bound

Durkee Mfg. Co., Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
National Vulcanized Fibre Co., Lestershire Spool Div., Johnson City, N. Y.

REELS—Plywood

Carris Reels, Inc., Rutland, Vt.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Seymour & Peck Div., The Greif Bros. Cooperage Corp., Chicago, Ill.

REELS & SPOOLS—Steel (All Types)

Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
National Vulcanized Fibre Co., Lestershire Spool Div., Johnson City, N. Y.
New York Engineering Corp., Yonkers, N. Y.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS—Steel, for Rope and Cable

New York Engineering Corp., Yonkers, N. Y.

REELS—Wire Mill

Acrometal Products, Inc., Minneapolis, Minn.
Apco Mossberg Co., Attleboro, Mass.
Boonton Molding Company, Boonton, N. J.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Molded Fiber Glass Tray Co., Linesville, Pa.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.
National Vulcanized Fibre Co., Lestershire Spool Div., Johnson City, N. Y.
Nilson, A. H. Machine Co., Shelton, Conn.
Republic Steel Corp., Pressed Steel Div., Cleveland, Ohio
Richard-Stuart Manufacturing Corp., Phila., Pa.
Seymour & Peck Div., The Greif Bros. Cooperage Corp., Chicago, Ill.
Wardwell Braiding Machine Co., Central Falls, R. I.

REELS & SPOOLS—Wood

American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., The, Hazardville, Conn.
Carris Reels, Inc., Rutland, Vt.
Durkee Mfg. Co. Inc., Pine River, Minn.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
McCaskie, Inc., William, Westport, Mass.
Seymour & Peck Div., The Greif Bros. Cooperage Corp., Chicago, Ill.

REFRACTORIES—High Temperature

Norton Company, Worcester, Mass.

ROD BAKERS—

(See OVENS—Rod Bakers)

RODS—Stainless Steel

American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Pittsburgh Steel Co., Pittsburgh, Pa.

RODS—Wire—Non-Ferrous

Aluminum Company of America, Pittsburgh, Pa.
Platt Bros. & Co., The, Waterbury, Conn.
Scovill Mfg. Co., Waterbury, Conn.

RODS—Steel

American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Niederrheinische Huette, A. G., Duisburg, Germany
Pittsburgh Steel Co., Pittsburgh, Pa.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

ROPE—Wire

Bethlehem Steel Co., Bethlehem, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.

RUST PROOF COMPOUNDS—

(See COMPOUNDS—RUST Preventing)

RUST REMOVING COMPOUNDS—

(See COMPOUNDS—RUST Preventing)

SATURATION SYSTEMS—

Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc. (used) Pawtucket, R. I.

SOAPS—Industrial and Wire Drawing

(See COMPOUNDS—Wire Drawing)

SPOOLS—Plastic

Boonton Molding Company, Boonton, N. J.
Hubbard Spool Company Div., The American Pulley Co., Garrett, Ind.
Molded Fiber Glass Tray Co., Linesville, Pa.
National Vulcanized Fibre Co., Lestershire Spool Div., Johnson City, N. Y.
Plastic Mold & Engineering Co., Providence, R. I.
Standard Mill Supply Co., Pawtucket, R. I.

STAMPINGS—Steel

Acrometal Products, Inc., Minneapolis, Minn.
Mossberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

STOCK STORAGE SYSTEMS

Jarke Manufacturing Co., Chicago, Illinois

STRIP—Steel

Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's, John A. Sons Corp., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

TANKS—Ceramic, for Galvanizing

Ofenbau Fritz G.m.b.H. & Co. K. G. Hagen, (W.-Germany)

TANKS—Compound

Watson Machine Co., Paterson, N. J.

TESTERS—INSULATION

(See MACHINERY—Spark Testers)

TESTING EQUIPMENT

(See MACHINERY Testing, Physical and Diameter Testing)

TINSEL—Electric Conductor

Montgomery Co., The, Windsor Locks, Conn.

TINSEL WIRE—Resistance, Lame, Decorative Cords Thread—Bare Copper Silver and False Gold Coated, etc.

(See TINSEL—Electric Conductor)

TOOLS—Nail Machine

Pittsburgh Carbide Die Co., Monongahela, Pa.

TRAMRAIL SYSTEMS—

Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

WHERE TO BUY, Continued

TRANSMISSIONS—Variable speed (See Adjustable Speed Drives)

TRAVERSES & DRUMS—For Reels
(See Drums & Traverses)

TRAVERSE MECHANISMS—
Davis Electric Co., Wallingford, Conn.
Emory Company, Robert J., Newark, N. J.
Hodge Bros. Machine Shop, Ossining, N. Y.
New England Butt Co., Division of Wanskuck Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.
Western Wire & Textile Machinery, Inc., So. San Francisco, Calif.
Wire & Textile Mach'y, Inc. (used) Pawtucket, R. I.

VARNISHES & LACQUERS—for Electric Wire
General Electric Company, Insulating Materials Section, Schenectady, N. Y.
Shawinigan Resins Corporation, Springfield, Mass.

VULCANIZING PANS AND EQUIPMENT—
American Insulating Mach'y Co., Phila, Pa.
Littler, C. A., Co., Inc., Cleveland, Ohio
Mosberg Pressed Steel Corp., Division of Wanskuck Co., Attleboro, Mass.

WAXES—for Insulated Wire
Cary Chemicals, Inc., New Brunswick, N. J.

WELDERS—Spot and Butt and Welding Wire Fabrics
Eisler Engineering Corp., Newark, N. J.
Micro Products Co., Chicago, Ill.
National Electric Welding Machines Co., Bay City, Michigan
H. A. Schlatter, Ltd., Zollikon-Zurich

WHEELS—for Printing on Electric Wire
Frank Daniels & Co., New York, N. Y.
Gem Gravure Company, West Hanover, Mass.
Gillies, Duncan M., Co. Inc., Boylston, Mass.

WIRE—Aluminum
Aluminum Company of America, Pittsburgh, Pa.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Ball
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Barbed
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.

WIRE—Brass and Bronze
Malin & Co., The, Cleveland, Ohio
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Scovill Mfg. Co., Waterbury, Conn.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Cadmium
Stamford Processing Co., Peekskill, N. Y.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Clad and Plated
Sylvania Electric Products Inc., Warren, Pennsylvania

WIRE—Cold Heading
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Pittsburgh Steel Co., Pittsburgh, Pa.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Copper
Malin & Co., The, Cleveland, Ohio
Sylvania Electric Products Inc., Warren, Pennsylvania
United Wire & Supply Corporation, Providence, R. I.

WIRE—For Electrical Conductors
Aluminum Company of America, Pittsburgh, Pa.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Flat
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
Montgomery Co., The, Windsor Locks, Conn.
National Standard Company, Niles, Mich.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Sylvania Electric Products Inc., Warren, Pennsylvania
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Galvanized
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
National Standard Company, Niles, Mich.
Roebling's, John A. Sons Corp., Trenton, N. J.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—High Carbon
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Manufacturers
Aluminum Company of America, Pittsburgh, Pa.
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Lock Washer Company, The, Newark N. J.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Republic Steel Corporation, Pressed Steel Div., Cleveland, Ohio
Roebling's, John A., Sons Corp., Trenton, N. J.
Scovill Mfg. Co., Waterbury, Conn.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
Sylvania Electric Products Inc., Warren, Pennsylvania
United Wire & Supply Corporation, Providence, R. I.
U. S. Steel Corp., N. Y., N. Y.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Metalizing
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
Platt Bros. & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WIRE—Music
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Worcester Wire Works Div., National-Standard Company, Worcester, Mass.

WIRE—Needle
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Alloy
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.

WIRE—Nickel Silver and Phosphor Bronze
Malin & Co., The, Cleveland, Ohio
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
United Wire & Supply Corporation, Providence, R. I.

WIRE—Oil Tempered
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Malin & Co., The, Cleveland, Ohio
Pittsburgh Steel Co., Pittsburgh, Pa.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Special Shapes
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
Continental Steel Corp., Kokomo, Ind.
National Lock Washer Company, The, Newark, N. J.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Sylvania Electric Products Inc., Warren, Pennsylvania
United Wire & Supply Corporation, Providence, R. I.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Spring
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Roebling's John A., Sons Corp., Trenton, N. J.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
United Wire & Supply Corporation, Providence, R. I.
Webb Wire Div., Carpenter Steel Co., New Brunswick, N. J.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Firth Sterling, Inc., Pittsburgh, Pa.
Malin & Co., The, Cleveland, Ohio
National Lock Washer Company, The, Newark, N. J.
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Webb Wire Div. Carpenter Steel Co., New Brunswick, N. J.

WIRE—Steel—Also Coppered and Galvanized Steel
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
American Steel & Wire Div., United States Steel Corp., Cleveland, O.
Bethlehem Steel Co., Bethlehem, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Malin & Co., The, Cleveland, Ohio
National Standard Company, Niles, Mich.
Pittsburgh Steel Co., Pittsburgh, Pa.
Porter Company, Inc., H. K., Riverside—Alloy Metal Division, Riverside, N. J.
Roebling's, John A., Sons Corp., Trenton, N. J.
Sheffield Division, Armco Steel Corporation, Kansas City, Mo.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Straightening and Cutting
American Chain & Cable, Page Steel and Wire Division, Monessen, Pa.
Colorado Fuel and Iron Corporation, Pacific Coast Division, Oakland, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
United Wire & Supply Corporation, Providence, R. I.
Wickwire Brothers, Inc., Cortland, N. Y.
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp., New York, N. Y.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.
Stamford Processing Co., Peekskill, N. Y.

WOOD—for Guide, Rolls, Bushings, Wear Parts, etc.

WRAPPING PAPER—Creped
(See PAPER—Creped Wrapping)

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

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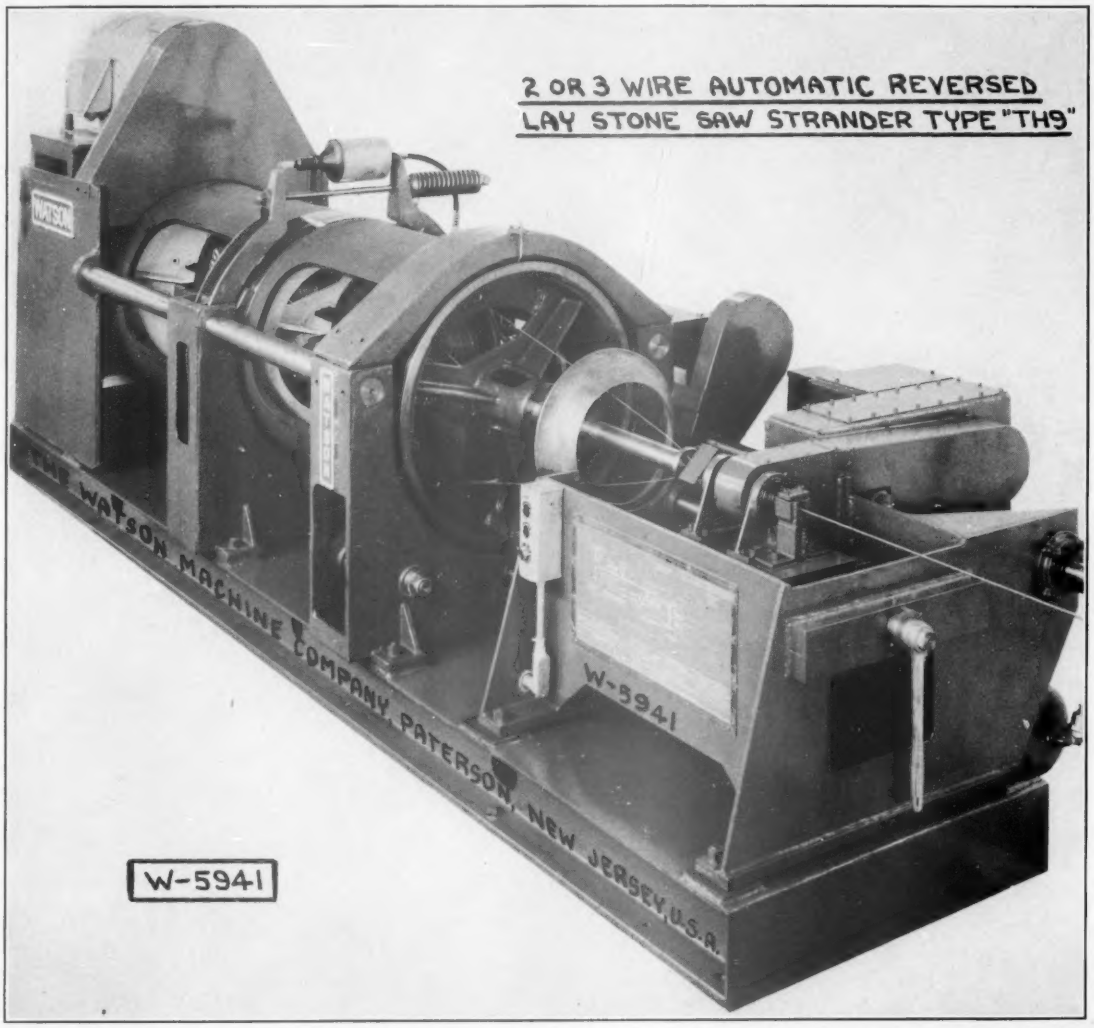
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AUTOMATIC STOPS. AIR-RELEASED BRAKE. WEAR GUARDS. MINIMUM TORSION CRADLE NOSE GUIDES. SHAFTLESS NO-LOOSE-PARTS INTEGRAL FRICTION CRADLES. SINGLE SPIDERS. CAPSTANS AND TAKEUPS TO MEET ANY REQUIREMENTS. ALL ELECTRICALS INSTALLED, WIRED AND READY FOR OPERATION. FURTHER DETAILS AND PERFORMANCE FIGURES UPON REQUEST.

12-58

FURNACES

FOR EVERY INDUSTRIAL HEAT TREATING PROCESS

We specialize in designing and building production furnaces; special atmosphere generators; time and labor saving material handling and other auxiliary equipment.

EF

Fuel Fired and Electric Furnaces for processing strip, wire, tubing, stampings, castings, forgings and other ferrous and nonferrous products in any shape or form.

1959 **1959**

JANUARY

SUN	MON	TUE	WED	THU	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

FEBRUARY

SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

MARCH

SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

APRIL

SUN	MON	TUE	WED	THU	FRI	SAT
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

MAY

SUN	MON	TUE	WED	THU	FRI	SAT
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24/31	25	26	27	28	29	30

JUNE

SUN	MON	TUE	WED	THU	FRI	SAT
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

JULY

SUN	MON	TUE	WED	THU	FRI	SAT
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

AUGUST

SUN	MON	TUE	WED	THU	FRI	SAT
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23/30	24/31	25	26	27	28	29

SEPTEMBER

SUN	MON	TUE	WED	THU	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

OCTOBER

SUN	MON	TUE	WED	THU	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

NOVEMBER

SUN	MON	TUE	WED	THU	FRI	SAT
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

DECEMBER

SUN	MON	TUE	WED	THU	FRI	SAT
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

The Electric Furnace Co., Salem, Ohio

Gas Fired, Oil Fired and Electric Furnaces — For Any Process, Product or Production

Free 1959 Calendars with Special Atmosphere Chart on back are available on 8"x11" and pocket size cards. Please advise how many you need and mention this Magazine.